Exhumation of the Baranof Schist in Whale Bay, Alaska determined through zircon fission track dating

by

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Submitted in partial fulfillment of the requirements for the degree of Bachelor of Science Department of Geology

UNION COLLEGE

June 2014

ABSTRACT

KAMINSKI, KATE MARISSA. Exhumation of the Baranof Schist in Whale Bay, Alaska determined through zircon fission track dating. Department of Geology, Union College, Schenectady, New York, May 2014.

During the Eocene in the North Pacific, the Kula, Farallon, and Pacific plates met in a trench-ridge-trench triple junction, bordered to the east by a continental margin along the edge of the North American plate. The flysch of the Chugach-Prince William terrane, a deformed accretionary complex, accreted onto this margin in the late Cretaceous to Paleocene. This terrane is framed to the north by the Border Ranges fault, a large strike-slip fault system that has accommodated northward movement of the Chugach-Prince William since the Eocene. One of the easternmost units of the Chugach-Prince William is the Baranof Schist on Baranof Island, a metasandstone unit metamorphosed to garnet-biotite to andalusite grade near the Crawfish Inlet pluton ca. 47-52 Ma. The Crawfish Inlet pluton is the youngest of a series of plutons of the Sanak-Baranof plutonic belt, which decreases in age from west to east, beginning with 61 Ma on Sanak Island. The Baranof Schist experienced post-intrusive cooling after the metamorphic event and this cooling was determined through zircon fission track dating. Twelve samples from a transect of Whale Bay on Baranof Island were collected for analysis to determine the thermal and tectonic history of the schist unit. Zircon fission track cooling ages indicate that the Baranof Schist cooled uniformly but relatively slowly, as young fission track ages are between 27-39 Ma. Six of the samples are overdispersed, failing χ^2, and have two age populations potentially reflecting different thermal events at ~42 and ~35 Ma. The younger of the two populations of cooling ages are consistent with cooling ages from those samples that passed χ^2 and reflect cooling of the Baranof Schist after intrusion of the Crawfish Inlet pluton. Combining these fission track data with cooling ages from other studies produces the cooling curve of the Baranof Schist, which shows that cooling of the unit lasted from 42 Ma until at least 27 Ma. This cooling curve can be compared to the cooling of the Leech River Schist and the Chugach metamorphic complex, two metamorphosed units believed to have been contiguous with the Baranof Schist at 50 Ma. The Chugach metamorphic complex to the north of the Baranof Schist began cooling 52-55 Ma and the Leech River Schist on Vancouver Island began cooling 49-50 Ma. It is hypothesized that these three units were accreted as a belt and were then metamorphosed successively by the passing of a slab window between the Kula and Farallon plates. After metamorphism, the Baranof Schist and Chugach metamorphic complex were translated northward as indicated by paleomagnetic data, while the Leech River Schist remained in place.

DEDICATION

I would like to dedicate this work to my parents and family, who have endlessly supported me through my education. Without their love and support I could never have accomplished what I have and would not be the person I am today. I would also like to dedicate my work to Professor John Garver, who has been a teacher and mentor to me throughout my college career. Without his encouragement and guidance my research would have never been possible and I would not have developed such a love for geology.

ACKNOWLEDGEMENTS

I would like to thank all those who helped in the progress and success of this project over the past year. First I would like to thank John Garver (Union College) and Cameron Davidson (Carleton College), the project leaders, for providing me with the incredible opportunity to carry out this research and for allowing students to be a part of such an amazing project. I would also like to thank the rest of our team for all the work they have done and support they have given me: Meghan Riehl, Brianna Rick, Brian Frett, Claudia Roig, and Adrian Wackett.

This project was part of a larger Keck Consortium project made possible through funding from the National Science Foundation (NSF EAR 1116554 to Garver; EAR 1116536 to Davidson; EAR 1062720 to Varga) and the Keck Geology Consortium. Additional funds were contributed by the Union College Geology Field Fund. Special thanks to Darrel Cowan from the University of Washington for joining us in the field and Peter Haeussler from the USGS, both of whom shared their insight and knowledge of the region. I would like to thank the entire Union Geology Department, in particular Holli Frey and Deb Klein for helping put together this and previous Keck projects and ensuring their success, and for supporting me through my geology career and encouraging my passion for geology to grow more every day. Additional thanks to Davey Lubin and the Esther G II, Lisa Busch and the Sitka Sound Science Center, and the countless other friends and geologists we encountered along the way who made this experience and research all the more worthwhile.

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INTRODUCTION

The southern part of the Alaska continental margin consists of a deformed accretionary prism that lies on the boundary of the Pacific and North American plates. The margin is tectonically active, with subduction and strike-slip motion occurring along a series of faults, notably the Denali, Fairweather, and Chatham Strait Faults. During the Eocene, this region underwent extreme transformation as the plates of the North Pacific reorganized and Kula-Farallon-Pacific trench-ridge-trench triple junction migrated (Scharman and Pavlis, 2012; Plafker et al., 1994). At this time, the Chugach-Prince William terrane may have been translated northward 1100 km from its proposed original position of 48º N, near modern-day Vancouver Island (Cowan, 2003; Pavlis and Sisson 2003).

The Chugach-Prince William terrane (CPW) was accreted during the Mesozoic and early Cenozoic along the North American continental margin, but the location of accretion is not well known. This terrane is a 2200 km-long forearc accretionary complex composed primarily of Maastrichtian to Paleocene deep-water turbidites and volcaniclastics (Plafker et al., 1994). The easternmost units of the CPW exposed on Baranof Island are the Sitka Graywacke and Baranof Schist, coeval units separated by the Crawfish Inlet pluton (Karl et al., 2014). The Sitka Graywacke turbidites (flysch) are composed of fine- to coarse-grained sandstones inferred to have been deposited in an oceanic trench along the continental margin (Haeussler et al., 2004).

The flysch was metamorphosed to prehnite-pumpellyite facies or higher metamorphic grade through burial and underplating soon after deposition (Plafker et al., 1994; Haeussler et al., 2004). The accretionary prism was then intruded by near-trench plutons, and the local metamorphic grade reflects this late high-temperature event. The Baranof Schist is part of the flysch and basalt assemblage of the Chugach terrane, interpreted to be equivalent to the Sitka Graywacke, metamorphosed to garnet-biotite grade and local andalusite grade at the contact of the pluton (Loney et al., 1975; Loney and Brew, 1987; Gasser et al., 2012; Karl et al., 2014). Little else is known about the Baranof Schist besides its presumed equivalence with the Sitka Graywacke. Accretion ages of the Sitka Graywacke range from 72-105 Ma, which is likely comparable for the Baranof Schist, as they are assumed to be the same unit at different metamorphic grades (Haeussler et al. 2004). The late, high-grade metamorphism of the Baranof Schist was caused by contact with the intruding Crawfish Inlet Pluton, a tonalite and granodiorite plutonic body of the Sanak-Baranof plutonic belt, at 50 Ma (Plafker et al., 1994; Zumsteg et al. 2003).

After intrusion by the Crawfish Inlet pluton, the Baranof Schist cooled. The Baranof Schist is exposed in Whale Bay on Baranof Island, and its cooling pattern can be determined through zircon fission track dating. Previous projects in southeastern Alaska show a uniformity of cooling ages in the units of the CPW, which perhaps may be apparent in Whale Bay as well. The westernmost units of the belt on the Sanak and Nagai Islands were intruded by plutons 58-61 Ma and demonstrate cooling ages of 44-

53 and 45-55 Ma respectively (DeLuca, 2013). In Prince William Sound, plutons of 52-56 Ma intrude samples with cooling ages of 43-53 Ma and 25-35 Ma (Izykowski, 2011; Milde, 2011; Carlson, 2012). Cooling ages in the Chugach metamorphic complex to the northwest of the Baranof Schist show metamorphism as young as 60 Ma with cooling ages of 51-46 Ma (Gasser et al., 2012). ZFT analysis will reveal how the cooling ages of the Baranof Schist correlate to other units of the CPW.

The cooling of the Baranof Schist may be analogous to that of the Chugach metamorphic complex and Leech River Schist, both of which are often considered to be units of the CPW. The CMC is characterized by low-pressure and high-temperature metamorphism and dramatic Eocene cooling (Pavlis and Sisson, 2003). The CMC exhibits rapid cooling immediately after intrusion followed by a period of much slower cooling occurring over 30 Myr or more (Gasser et al., 2012). Far to the south on southern Vancouver Island, the Leech River Schist is hypothesized to be a unit of the CPW that was not translated along with the rest of the terrane during the Eocene (Cowan, 2003; Groome et al., 2003). The LRS was metamorphosed during intrusion and then underwent rapid cooling, until it was completely cooled 34-36 Ma (Groome et al., 2003).

The metamorphism and subsequent cooling of both of these adjacent (or presumed adjacent) metamorphic units may be related to the cooling of the Baranof Schist, and if so, their distribution may indicate that there was a large-scale regional process that heated the units and then they were systematically or progressively cooled. This paper aims to determine the cooling ages of the Baranof Schist through ZFT and explore the significance of comparisons between its cooling pattern and those of other units in the CPW. The cooling ages of the Baranof Schist and its neighbors may have implications for the thermal history of the CPW before the Eocene and from this, we may be able to discern more about the tectonic history and translation.

GEOLOGIC BACKGROUND

The Alaska Continental Margin

The southern part of the Alaska continental margin consists of deformed accretionary prism formed by subduction-related underplating, metamorphism, and strike-slip faulting. The southern margin of Alaska is composed of four major terranes: the Chugach, Prince William, the colliding Yakutat, and the modern accretionary complex (Fig. 1). The continental margin is a Mesozoic and Cenozoic large-scale accretionary complex comprised of four exposed assemblages bounded by the Border Ranges fault to the north (Plafker et al., 1994). These four assemblages, the Chugach, Ghost Rocks, Prince William, and Yakutat terranes, have been accreted since the Cretaceous (Plafker et al., 1994). The Chugach terrane, bordered to the north by the Border Ranges fault, contains the Upper Triassic-Cretaceous McHugh Complex and the Upper Cretaceous to Paleogene Valdez Group. The more outboard Prince William terrane is comprised of Paleocene to Eocene turbidites of the Orca Group, separated from the Chugach by the Contact fault (Gasser et al., 2012). The intervening Ghost

Rocks is a mélange that sits between the Chugach and Prince William terranes. The Yakutat terrane is the southernmost unit of the composite terrane and is composed of oceanic and continental basement rocks and Neogene clastic rocks that are actively colliding with the Alaskan margin (Plafker et al., 1994). The Yakutat was displaced at least ~600 km along Queen Charlotte-Fairweather transform faults during late Cenozoic and then began to underthrust the Prince William terrane (Plafker et al., 1994).

Also situated along the Alaska continental margin in a more inboard position is the Wrangellia composite terrane, north of the Border Ranges fault system (Plafker et al., 1994). The Wrangellia composite terrane is composed of Peninsular, Wrangellia, and Alexander terranes, all Paleozoic and Mesozoic magmatic arc complexes (Plafker et al., 1994). Paleomagnetic data places the location of these three terranes 30º south of their present location during the Late Triassic (Plafker et al., 1994). By the mid-Cretaceous (or possibly by the Middle Jurassic), the composite terrane was accreted onto the North American margin (Plafker et al., 1994).

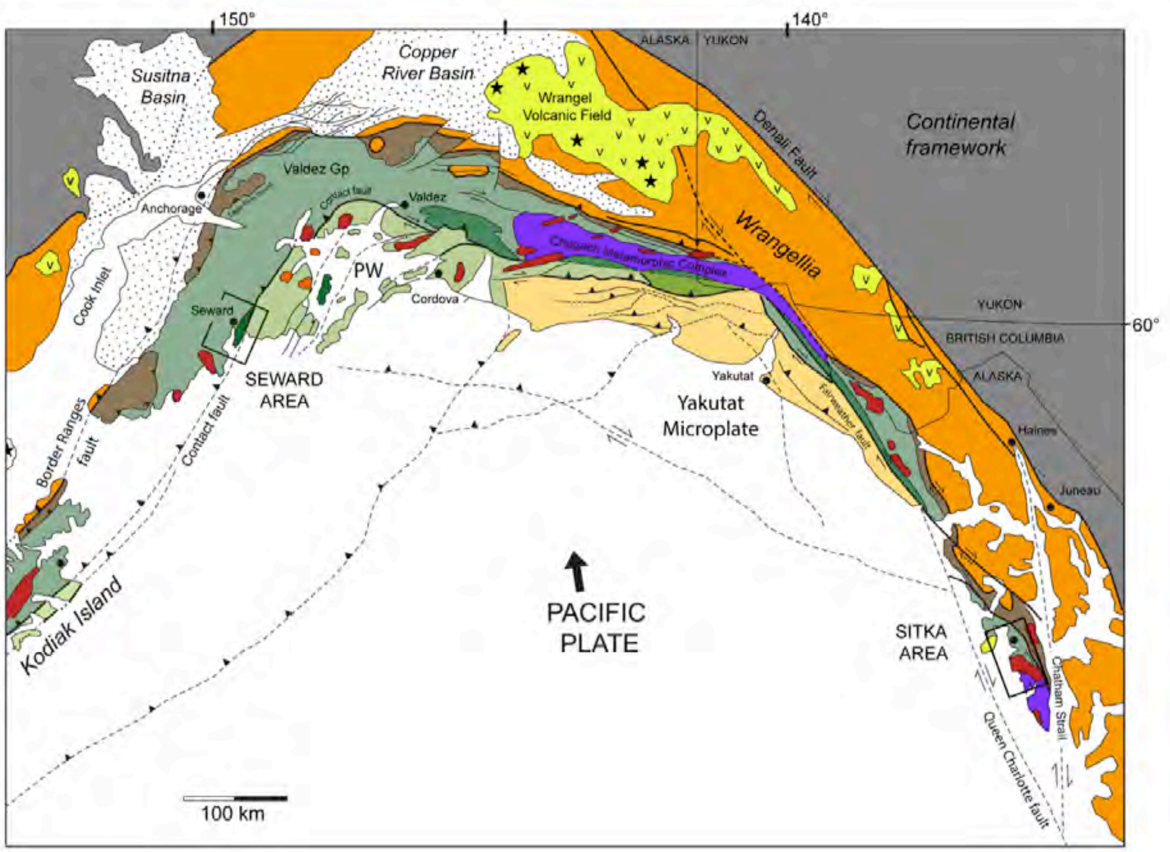


Figure 1. Geologic overview of the continental margin southeastern Alaska. The Chugach-Prince William terrane is cut off from more inboard rocks by the Border Ranges fault system (Gasser et al., 2012).

The Chugach-Prince William Terrane

The Chugach-Prince William terrane (CPW) is a Mesozoic and Cenozoic accretionary complex that extends 2200 km along the Alaska continental margin from

Sanak Island to Chatham Strait. The flysch of the CPW was accreted along the margin from the Cretaceous to early Tertiary as a thick clastic package of trench-fill deposits when the trench-ridge-trench triple junction of the North Pacific subducted beneath the North American plate (Cowan, 2003; Amato and Pavlis, 2010). In its modern day location it is bounded by a series of dextral strike slip faults including the Border Ranges fault to the north, the Contact fault system between the terranes, and, to the east, the Fairweather, Chatham Strait, and Queen Charlotte faults (Plafker et al., 1994). Paleomagnetic data indicate that elements of the CPW were not deposited at the present latitudinal position, but rather at a more southerly position of 48º N or even farther south (see Cowan, 2003) (Fig. 2, 3). The Cowan hypothesis, which is based on offsets of geologic units, suggests that the CPW was translated northward after 50 Ma along the continental margin a maximum of 1100 km. This extensive margin-parallel movement was accommodated through strike-slip motion along the Border Ranges fault and modern strands of the Denali, Queen Charlotte, and Fairweather faults (Plafker et al., 1994; Cowan, 2003).

The flysch of the CPW is composed of Cretaceous to early Tertiary flysch, mafic volcanics, mélange, and ophiolitic rocks interpreted to been formed and/or offscraped in a deep-water trench (Plafker et al., 1994). In this study the primary stratigraphic unit is referred to as the Upper Cretaceous Sitka Graywacke (Plafker et al., 1994; Zumsteg et al., 2003). After deposition, the Sitka Graywacke was intruded by the Eocene Crawfish Inlet pluton (50 Ma), an intrusive body of the time-transgressive Sanak-Baranof plutonic belt of near-trench plutons (Wackett et al., 2014). This pluton caused contact metamorphism of the Sitka Graywacke to produce what is now considered the Baranof Schist, a garnet-andalusite grade unit of the flysch and basalt assemblage of the Chugach terrane (Loney et al., 1975). Thus, the unit was buried and metamorphosed, and then thermal conditions were greatly elevated during contact metamorphism caused by a slab window (Zumsteg et al., 2003).

Tectonic and paleomagnetic data provide evidence that the CPW formed south of its present location and is interpreted to have formed in a trench offshore modern-day British Columbia during the Late Cretaceous to early Cenozoic. The complex was then transported northward approximately 2000 km by margin-parallel dextral strike-slip motion. Paleomagnetic data show that rocks of the Paleocene to early Eocene in the Chugach and Prince William terrane moved 2000 km northward since 55-60 Ma, while rocks situated on the North American plate show little to no displacement (Pavlis and Sisson, 2003).

Metamorphism of the CPW is divided into two main events. The first was a lowgrade regional metamorphic event that produced prehnite-pumpellyite and lower greenschist facies, due to typical cycling of rocks through an underplating, heating, cooling, and exhumation process within the accretionary prism. The second event was a regional thermal event driven by the intrusion of the Crawfish Inlet pluton that overprinted the first event and produced metamorphic rocks in the biotite-sillimanite zone (Zumsteg et al., 2003). The calculated conditions during the Crawfish Inlet intrusion are

575-755º C and 3.4-6.9 kbar, which produced high-temperature garnet and andalusite zones in the Baranof Schist (Zumsteg et al., 2003).

The Baranof Schist is believed to correlate with the Leech River Schist on Vancouver Island, a metamorphic complex of similar age but more southerly location (Cowan, 2003). This hypothesis maintains that when both units were situated at this paleolatitude, they were intruded and metamorphosed simultaneously at 50 Ma. After intrusion, the Leech River Schist remained in place as the majority of the CPW including the Baranof Schist was translated northward along the continental margin through strike slip motion (Cowan, 2003).

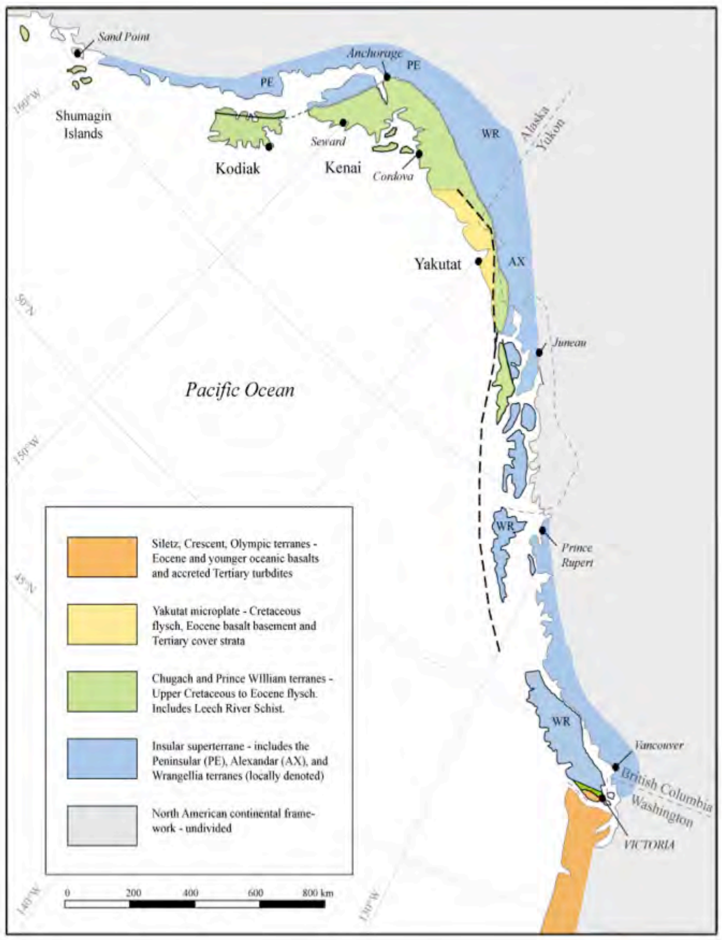


Figure 2. The modern-day location of the Chugach-Prince William terrane (modified from Cowan, 2003).

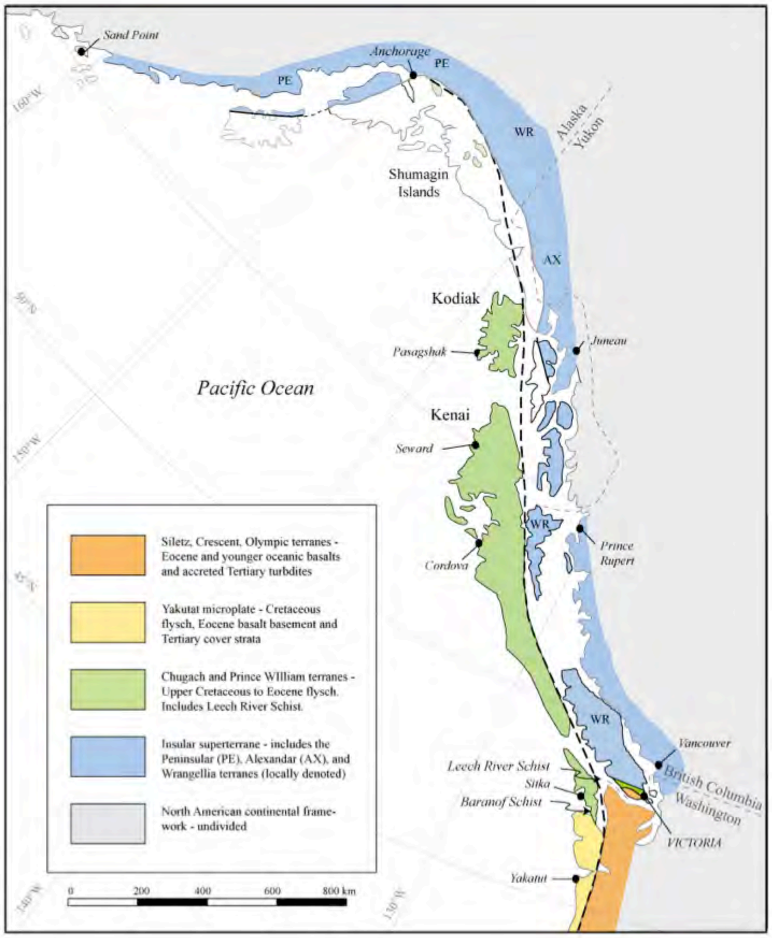


Figure 3. Proposed position of the Chugach-Prince William terrane ~50 Ma. The terrane and Baranof Schist would have been accreted further south than its present location, closer to Vancouver Island at about 48° N (modified from Cowan, 2003).

The Chugach Metamorphic Complex

To the north and west of the CPW, the Chugach metamorphic complex (CMC) lies along the forearc of the Alaskan-Aleutian arc. The CMC experienced high-temperature and low-pressure metamorphism in the Early Eocene, presumably associated with the migration of the ridge-trench triple junction along the margin (Plafker et al., 1994; Scharman & Pavlis, 2012). The CMC is composed of homogeneous interbedded graywackes and argillites of andalusite-sillimanite facies, interpreted to be turbidities of the Chugach-Prince William terrane deposited in the Late Cretaceous to Early Tertiary (Pavlis and Sisson, 2003). U-Pb ages on zircon place the maximum depositional age of the CMC at ca. 60 Ma, and metamorphism began ca. 55-54 Ma (Early Eocene). Peak metamorphism occurred over a period of 0-3 Myr, likely ca. 55-52 Ma, with most cooling ages at ca. 51-46 Ma (Gasser et al., 2012).

The Sanak-Baranof belt and the Crawfish Inlet Pluton

The Sanak-Baranof plutonic belt in southeastern Alaska extends 2000 km along the Alaskan margin from Sanak Island to Baranof Island. The belt is composed of plutons of tonalitic, granodioritic, and granitic compositions (Gasser et al., 2012). The

Sanak-Baranof belt is inferred to have been produced from ridge-trench interaction. There is some question whether the ridge belongs to the Kula-Farallon spreading ridge or the Pacific-Resurrection spreading ridge (cf. Cowan 2003 and Haeussler et al., 2003). The subduction of the ridge and the open slab window to the asthenosphere produced enough heat to cause plutonism and local metamorphism of the Chugach accretionary complex (Zumsteg et al., 2003).

The approximate ages of the plutons that make up the Sanak-Baranof are 61 Ma in the west and 50 Ma in the southeast, generally younging to the east along the margin (Fig. 4) (Bradley et al., 2003). This along-margin age progression is the result of the oblique subduction of the spreading ridge below the accretionary prism or the translation of rocks along the margin (Cowan, 2003; Gasser et al., 2012). One of the younger plutons of the belt (thus the farthest to the east) is the Crawfish Inlet pluton, which intruded the Chugach accretionary complex and the easternmost Prince William terrane. The Crawfish pluton intruded the CPW rocks shortly after accretion 47-52 Ma (Wackett et al., 2014). The intrusion caused contact metamorphism in the CPW rocks, which produced high-grade metamorphic rocks, including the Baranof Schist on the southwestern portion of Baranof Island.

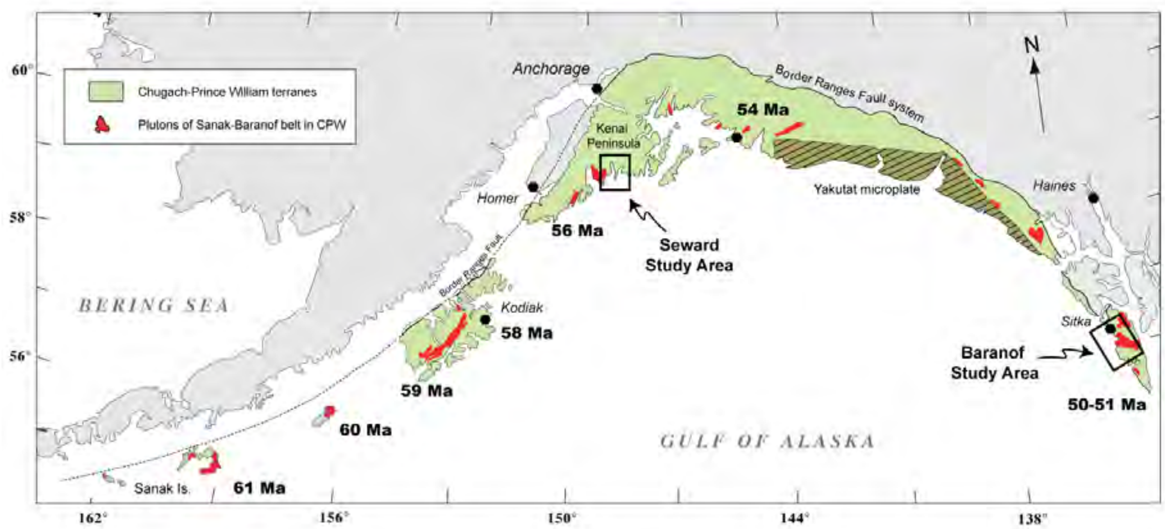


Figure 4. The Chugach-Prince William terrane and the intruding plutons of the Sanak-Baranof plutonic belt. The plutons decrease in age from west to east, beginning with the oldest plutons on Sanak Island (61 Ma) and ending with the youngest on Baranof Island (50-51 Ma) (from Roeske et al., 2003. Pluton ages from Farris and Patterson, 2009; Bradley et al., 2003).

Tectonic Reconstruction of the North Pacific During the Eocene

Before Eocene plate reorganization at 55 Ma, three major plates in the North Pacific, the Kula, Farallon, and Pacific, met in a trench-ridge-trench triple junction, which was originally located near present-day Vancouver Island or farther south (Scharman and Pavlis, 2012; Plafker et al., 1994). The Kula and Farallon plates began moving northward 55 Ma in relation to the North American plate, and the Kula-Farallon ridge was subducting beneath the North American plate perpendicular to the continental margin

(Plafker et al., 1994). This movement was accommodated by underthrusting of the plates beneath the continental margin and dextral oblique strike-slip motion (Plafker et al., 1994).

The demise of the Kula-Farallon ridge occurred in the Middle Eocene (50-53 Ma). A coeval thermal event produced plutonism and caused low-pressure, high-temperature metamorphism in the CPW and Yakutat terranes (Plafker et al., 1994). From 48-35 Ma, the Transition fault developed in the northeastern Gulf of Alaska (Plafker et al., 1994). The northwest subduction of the Pacific plate and Yakutat terrane (up to 1000 km since 20 Ma) was accommodated on the Queen Charlotte-Fairweather fault system and the Transition fault (Plafker et al., 1994).

During and after the Eocene, the plates of the North Pacific reorganized and margin parallel slip moved the CPW northward. There are three potential models for this event to explain the motion of the CPW and the fate of the oceanic plates. The first reconstruction is the Resurrection plate model, in which a fourth plate is hypothesized in the north Pacific (Pavlis and Sisson, 2003; Haeussler et al., 2003). The Resurrection plate would have been located on the Kula-Farallon spreading center, creating a second triple junction in the North Pacific and two ridges subducting beneath the North American plate: the Kula-Resurrection ridge and Resurrection-Farallon ridge (Scharman and Pavlis, 2012). The Resurrection plate would have completely subducted beneath the North American plate by 50 Ma, leaving little to no evidence of its existence (Haeussler et al., 2003).

The second plate reconstruction is the Kula-Pacific model, in which the Kula-Farallon spreading center is completely subducted and the Farallon-Pacific-North American triple junction migrates southward (Pavlis & Sisson 2003). After plate reorganization ending at 53 Ma, the Kula-Farallon ridge would then change direction and begin moving northwest (Gasser et al., 2012). The third reconstruction is the Kula-Farallon model, which involves the rapid spreading of the Kula-Pacific ridge. The resulting Kula-Farallon-Pacific triple junction migrates rapidly north along the margin (Pavlis and Sisson 2003). This scenario would have allowed the triple junction to jump to the north or rapidly migrate northwest of the CMC (Pavlis and Sisson 2003).

ZIRCON FISSION TRACK DATING

In thermochronology, zircon is an exceptionally useful mineral. Zircon ($ZrSiO_4$) is highly resistant to weathering and is found in many sedimentary, igneous, and metamorphic rocks (Bernet and Garver, 2005). Zircon crystals contain uranium and thorium, which decay through alpha decay and spontaneous fission, and the ability to quantify this relationship makes the minerals useful in many geo- and thermochronologic methods. However, in this study we focus only on detrital zircon fission track analysis and use the ratio of the parent isotope uranium (^{238}U) and fission tracks from spontaneous decay to determine cooling ages.

Detrital zircon fission track analysis is particularly useful in determining provenance of clastic sediments, exhumation of convergent mountain belts, and dating low-temperature metamorphic events (Bernet and Garver, 2005). DZFT thermochronology determines the cooling ages of a population of grains, allowing inferences to be made about the provenance and exhumation of a rock unit. Zircon grains within a rock sample may reveal varying ages as a result of different amounts of radiation damage (Garver et al., 2005).

Uranium concentrations in zircon are generally 200-450 ppm (Bernet and Garver, 2005). The fission of ^{238}U in the crystal structure creates fission tracks, or zones of disorder, in the crystal (Garver et al., 2005). The uranium atoms split into two daughter particles, which create ionization damage along their flight path in the crystal (Reiners and Brandon, 2006). As fission continues and damage accumulates, the zircon becomes increasing damaged and goes from a fully crystalline state to an amorphous or metamict state. Transitional zircons are those with an intermediate amount of damage somewhere between the crystalline and metamict stage. Transitional zircons have enough damage in their crystal structure to alter their physical properties, but are still able to be etched for fission track analysis. Metamict samples, on the other hand, are far too damaged to be analyzed for the purpose of fission track dating. Zircons used in this study were primarily transitional, showing a moderate amount of damage but not enough to make the grains uncountable.

Fission tracks in zircons can be annealed when exposed to certain temperatures. This annealing process involves healing of tracks through exposure to high heat for a prolonged amount of time, and then the tracks gradually shorten until they are virtually erased from the crystal structure (Bernet and Garver, 2005). The temperature below which tracks are completely retained and above which tracks are lost is the zircon partial annealing zone (zPAZ) (Bernet and Garver, 2005). The zPAZ is the temperature range in which fission tracks are typically retained in the crystal structure of a zircon, constrained to about 200-210º C for high-damage zircon to 280-300º C for undamaged zircon (Garver et al., 2005). The effective closure temperature is a temperature within the range of the zPAZ at which the fission track system closes and tracks are retained within the crystal. This temperature is ~240 ± 30º C in natural settings (Bernet and Garver, 2005; Brandon et al., 1998). Assuming a typical continental geotherm of 30º C/km, at the closure temperature of ~240º C, a zircon is at a depth of 7.5-8 km (Reiners and Brandon, 2006). Below the closure temperature, fission tracks within the zircon are retained and the number of tracks in a grain is a function of uranium concentration and time since closure. Above it, tracks are typically annealed.

Annealing or resetting of a zircon grain will heal radiation damage in the crystal structure, which is directly related to its uranium concentration. The amount of damage in a grain will affect its ability to anneal, and there are two end members of zircon that describe the two extreme cases of damage (Bernet and Garver, 2005). Low-retentive zircons (LRZs) and high-retentive zircons (LRZs) have varying amount of radiation damage in their crystal structure and have different annealing temperatures. LRZs have partially damaged structure due to significant radiation damage and anneal at low temperatures of approximately 180-200º C. HRZs are nearly crystalline and have far less damage than LRZs, and anneal at temperatures of 280-300º C or greater (Bernet and Garver, 2005). At low temperatures, LRZs are fully annealed but HRZs may be only partially annealed (Bernet and Garver, 2005). Partial annealing causes tracks to shorten and makes the grain appear younger with less damage. At high temperatures, all tracks in both LRZs and HRZs are completely annealed and produces grains that all appear to have a similar cooling age (Bernet and Garver, 2005).

Populations of zircon grains do not always anneal at the same temperature and thus can be described as having homogeneous or heterogeneous annealing characteristics. Grains may be homogeneous if they have the same amount of radiation damage and have a similar thermal history. These homogeneous grains will anneal at about the same temperatures and, when analyzed through fission track analysis, produce a $\chi^2 > 5\%$. Heterogeneous grains anneal at different rates and temperatures due to differences in amounts of radiation damage, and thus represent different thermal event ages. Grains from a heterogeneous population will produce a $\chi^2 < 5\%$, indicating that they originate from different source terranes and were thermally reset at different temperatures (Brandon et al, 1998).

To determine cooling ages of zircons using fission track analysis, the concentration of uranium atoms in the sample is determined through neutron irradiation. Samples are chemically etched prior to irradiation to reveal spontaneous, naturally occurring tracks and irradiation induced tracks, derived from ^{238}U and ^{235}U respectively (Bernet and Garver, 2005). The irradiation induces the fission of ^{235}U in a sample, which is recorded on the mica detector affixed to each sample mount (Reiners and Brandon, 2006). After irradiation, the $^{235}U/^{238}U$ ratio is used to calculate uranium concentration in the to give us a relative cooling age (Reiners and Brandon, 2006). The cooling age of a zircon provides evidence of the thermal history of the source rocks, as cooling is related to: 1) uplift and exhumation of the rocks; or 2) thermal events (Bernet and Garver, 2005).

METHODS

Twelve medium- to coarse-grained metasandstone and granite samples were collected from well-exposed outcrops along the shore of Whale Bay on Baranof Island. Samples collected belonged to the Paleocene Baranof Schist and the 50 Ma Crawfish Inlet pluton. From each location, 2-5 kg of whole rock was collected for later sample preparation and analysis (Fig. 5, 6). These samples were collected in a NE trending transect along Whale Bay. The Baranof Schist samples were collected from two units, KJsh and KJss, which have different compositions (Karl et al., 2014). Outcrops were accessed using inflatable Zodiac boats with 30 HP outboard motors. At each outcrop, the visible units were described and the location was recorded on a handheld Global Positioning System, then samples were bagged and labeled.

Figure 5. Thinly bedded metasandstone with interbedded mudstone of the Baranof Schist at sample location WB13-12 in Great Arm, Whale Bay. Zircons from this sample had two cooling age populations, 29.3 ± 2.85 Ma and 42.7 ± 3.0 Ma, due to overdispersion due to the retentiveness of the zircons.

Figure 6. Metamorphosed turbidite outcrop of the Baranof Schist from sample location WB13-13 on Makhnat Island in the mouth of Small Arm.

Zircon Extraction

Samples were processed according to standard procedures according to the Union College Fission Track Laboratory Manual and as described in Bernet and Garver (2005). Whole rock samples from the field were crushed into gravel-sized pieces using a Chipmunk jaw crusher, then further reduced in size using a Bico Braun® pulverizer with a Torit® dust collection system to contain fine particles. The crushing and grinding process produced a very fine- to fine-grained rock flour, which was placed on a Gemini® Gold Rogers table. The Rogers table sorts the heavy and light minerals within the sample by density, depositing them into different bins according to relative density, fractions A, B, C, and D. Fraction A contains samples of the greatest density, and fraction D samples of the lowest density. For our purposes, Fraction A contained the most desirable samples. All samples separated with the Rogers table were dried in the laboratory oven at 40º C for 24 to 48 hours. Dried samples were then ready for sieving. Generally, fractions C and D were bagged and set aside and fractions A and B were sieved using pans with +600 µm and +250 µm mesh. Fraction A was sieved first to collect a sample of approximately 200 ml. If not enough sample was produced from fraction A, fraction B was sieved until an appropriate sample size was obtained. Sieving ensures that only grains less than 250 µm in size will proceed to heavy liquid separation as these are the most likely to contain zircons.

The sieved samples then advanced to heavy liquid separation. The 200 ml mineral sample is placed in a solution of tetrabromoethane with a density of 2.96 g/cm^3, which allows particles with a greater density to settle out of solution. The particles that settled out were removed from the tetrabromoethane and rinsed with acetone and these heavy minerals were then passed through Frantz® magnetic separator multiple times to remove magnetic minerals. The samples were sent through the separator with the strength of the magnet increasing in 0.2 amp increments from 0.1 to 1.7 amps. Material that passed through the separator at 1.7 amps was then subjected to a second round of heavy liquid separation, using methylene iodide, with a density of 3.30 g/cm^3. In this step, zircon crystals will sink and become separated from less dense minerals (i.e. apatite). The zircon crystals are removed from solution and rinsed once again with acetone, then each sample is analyzed under an Olympus® binocular microscope to observe sample quality. In all samples, the zircon yield was very good.

Sample Preparation

To mount the zircon grains, 2 x 2 cm^2 PFA Teflon® squares were heated on a hot plate at 330º C. The zircons were then embedded into the Teflon using the glass-sandwich method. Two mounts were made for each sample. Zircons from dated age standards, the Fish Canyon Tuff and Peach Springs Tuff, were also mounted in the same manner as the unknown samples. The Teflon mounts were adhered to lucite cylinders using double sided tape to make polishing easier. The samples were cut using 800 grit sandpaper and polished by hand on a Buehler Automet® 200 Powerhead and EcoMet® 3000 Variable Speed Grinder/Polisher using first a 9 µm diamond suspension solution, followed by a 1 µm solution. The mounts were then polished for the last time using Micropolish II aluminum oxide slurry (0.3 µm). During the polishing process, Teflon mounts were frequently analyzed under 400x magnification to look for unpolished areas or scratching. Some samples had uneven top surfaces, resulting in unpolished areas, and thus had to be boosted up using extra pieces of double sided tape cut to the shape of the rough area. Samples were observed under magnification after polishing to ensure all mounts were not significantly scratched and were appropriately polished. Once the samples were polished, they were removed from the lucite and etched in a NaOH-KOH solution heated to the eutectic, 228º C, for 18-24 hours. NaOH-KOH is a basic solution that etches out fission tracks in a crystal produced by natural spontaneous uranium decay. Etch times were determined based on the assumed ages of the samples: younger samples need longer etch times, as they typically have less radiation damage and fewer tracks, while older samples need shorter etch times, as they have more damage. Zircons from the granite samples needed less etching time and received on average 18¼ hours.

Once samples were etched for the designated amount of time, they were removed and rinsed with water and placed in 100 ml of 6N hydrochloric acid to remove any residual etchant. Mounts were placed between two glass plates held by binder clips and heated to 228º C for 20 minutes, then cooled down to room temperature. This process is important in sample preparation because the zircon mounts typically become slightly distorted during the etching process, and this flattening restores them back to their initial form, making further analyses easier. Mounts were then rinsed with distilled water, followed by ethanol, and were then dried vertically over a hot plate at 100º C. After cooling, mounts were then fit with cut pieces of mica, Brazilian Ruby clear that was previously annealed at 500º C for one hour. Three Corning CN-5 glass dosimeters, which have a known uranium concentration of 12.17 ± 0.62 ppm, were also fit with mica. These dosimeters were placed at the front, middle, and back of the irradiation tube among the samples. The irradiation tube with samples and dosimeters irradiated in the USGS nuclear reactor in Denver, Colorado, receiving a nominal fluence of $2x10^{15}$ n/cm^2 (Irradiation U53Z, September 2013).

After irradiation, samples were “cooled” for 4 weeks to allow radioactive isotopes with shorter half-lives to decay. Samples were returned to the fission track lab at Union College and removed from the irradiation tube and unstacked. Each grain mount was marked with registration points in three corners using a carbide-tipped scribe. Mica detectors were separated from their respective Teflon® mounts and etched in 48% hydrofluoric acid for 18 minutes at room temperature (20-23° C). The mica was then cleaned with NaOH followed by water, then ethanol, and finally left to dry on a hot plate set at a low temperature. The Teflon® mounts and mica detectors were then mounted as mirror opposites on a glass slide using thin section epoxy. A glass cover slip was placed beneath the mica detector to equalize the difference in height between the two mounts.

Fission Track Counting

Natural and spontaneous fission tracks and induced fission tracks were counted under transmitted and reflected light, respectively, using an Olympus® BMAX-60 microscope at a magnification of 1250x. Zircon grains on the Teflon® mount were marked using a CalComp® digitizing tablet with FTStage v2.0 software. The marked mount was then navigated using a Kinetik® Automated Stage driven by the FTStage v2.0 software to analyze and grade each grain for quality and countability. A grain was considered countable if it met specified conditions/standards, including an absence of inclusions, little zonation, optical clarity, sufficient countable area, and an even uranium distribution (Bernet and Garver, 2005). Using a 10 x 10 grid in the eyepiece of the microscope, a region of the grain ideal for counting was selected. The spontaneous tracks within this designated area on the zircon were counted and then, using the automated stage software, induced tracks at the same location on the mica sheet were counted.

Spontaneous and induced track data from standard samples of known ages from the Fish Canyon and Peach Springs tuffs were used to calculate the zeta calibration factor. Track densities from each sample were run through the ZetaMean program, which produced calculated zeta factors. All zeta factors were then averaged to create an overall zeta factor from three irradiations. Induced tracks on the mica from the glass dosimeters were counted on the 10 x 10 grids to total over 2000 tracks. These data were used to calculate fluence distribution within the nuclear reactor and subsequently for each sample mount. The cooling age of each grain within a mount could then be calculated using the zeta calibration factor, the fluence, and the number of tracks through the ZetaAge program.

About 30 grains were counted on each unknown sample. Cooling ages for each grain as calculated by ZetaAge were further analyzed using BinomFit to determine the distribution of ages within each sample. BinomFit uses binomial peak-fitting software to create a probability density plot, which allows for the populations of age clusters to be identified and thus determine cooling trends within individual samples.

RESULTS

All twelve samples were taken from exposed schist and granite outcrops along Whale Bay. Detrital zircon fission track dating of all the samples reveals pooled and χ^2 cooling ages of 27-39 Ma. All cooling ages along the transect are statistically indistinguishable, displaying no trend of younging towards the pluton or otherwise (Fig. 7).

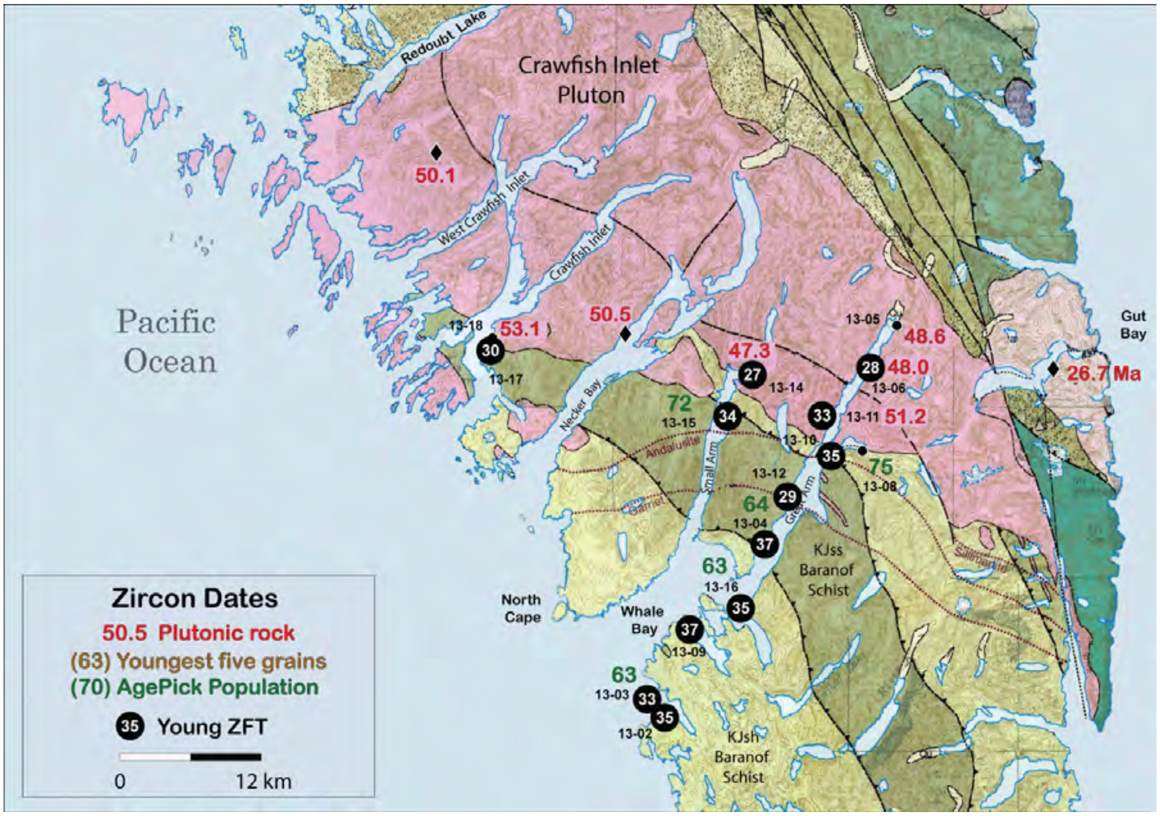


Figure 7. Sample map of Whale Bay with U-Pb ages of the schist and pluton (green and red, respectively) and young zircon fission track ages. The young ZFT ages are the χ^2 ages of the overdispersed samples and the pooled ages for the samples that passed χ^2 to represent the young grain populations and most recent thermal event (modified from Karl et al., 2014).

Figure 8. The author next to one of the basaltic dikes in Still Harbor where samples WB13-02 and WB13-03 were collected. Samples from this location have cooling ages of 34.6 and 32.8 Ma, respectively.

FT data were processed using ZetaAge and for those samples that passed χ^2, the pooled age of the sample was used. For samples that did not pass χ^2, the χ^2 age was used, which isolates the young population of grains in the sample and excludes the older population from the final age. Six samples passed χ^2 and six did not, and the latter display overdispersion and have some grains with ages older than the rest of the population. Using the χ^2 age eliminates these older grains that are inconsistent with the dominant young cooling ages. The χ^2 ages for overdispersed samples have a range of 27-37 Ma, showing a slightly younger population than that of the pooled ages. All samples, even those from the pluton and from the contact between the granite and schist, display similar ages. There is no distinguishable difference between the ages, regardless of whether or not they passed χ^2.

The schist of Still Harbor was intruded by a series of basaltic dike systems, where we collected two samples, WB13-02 and WB13-03 (Fig. 8). WB13-02 was collected 30 meters from the dike and its FT data produced a cooling age of 34.6 Ma. WB13-03A was collected from directly next to one of the dikes, within 30 cm, on the contact between the basaltic intrusion and the sandstone, and had a cooling age of 32.8 Ma. The ages of these samples, despite their proximity to the dikes, are statistically indistinguishable from other samples in Whale Bay.

Table 1: Zircon fission track data – Baranof Island

Sample	ρ_s	N_s	ρ_i	N_i	ρ_d	N_d	n	χ^2	Age*	-1σ	+1σ	Uranium
Whale Bay – Baranof Schist												
WB13-02A	5.59×10^6	1897	7.51×10^6	2550	2.710×10^5	2128	30	55.1	34.6	-1.5	+1.5	341.0±17.1
WB13-03A	6.38×10^6	2173	9.06×10^6	3086	2.713×10^5	2131	30	60.9	32.8	-1.3	+1.4	410.7±19.6
WB13-04B	8.00×10^6	2599	1.02×10^7	3299	2.718×10^5	2135	30	21.5	36.8	-1.5	+1.5	459.5±21.7
WB13-09A	7.31×10^6	2038	9.25×10^6	2578	2.723×10^5	2139	30	11.2	37.0	-1.6	+1.6	417.7±21.5
WB13-10A	8.55×10^6	2085	1.06×10^7	2579	2.727×10^5	2142	30	0.0	35.6	-1.5	+1.6	477.1±24.8
WB13-12A	6.41×10^6	1507	8.16×10^6	1919	2.733×10^5	2148	30	0.1	35.9	-1.7	+1.7	367.1±21.4
WB13-15A	6.05×10^6	1488	8.39×10^6	2062	2.740×10^5	2154	30	9.6	34.0	-1.6	+1.6	376.6±22.1
WB13-16A	6.76×10^6	1821	8.34×10^6	2248	2.743×10^5	2156	30	0.7	37.8	-1.7	+1.8	374.0±21.7
WB13-17B	8.45×10^6	1459	1.05×10^6	1809	2.748×10^5	2161	22	0.5	37.0	-1.8	+1.9	469.0±29.6
Whale Bay – Crawfish Inlet Pluton												
WB13-06A	7.69×10^6	2604	1.00×10^7	3402	2.720×10^5	2137	30	0.0	33.4	-1.4	+1.5	454.2±21.4
WB13-11A	1.05×10^7	2000	1.26×10^7	2411	2.730×10^5	2145	30	5.1	38.9	-1.7	+1.7	568.4±30.5
WB13-14A	6.26×10^6	1542	8.64×10^6	2129	2.737×10^5	2151	30	0.0	32.9	-1.5	+1.6	388.2±22.2

Note: In this table, Age* is the pooled age when the sample passes χ^2 and the χ^2 age if it fails. ρ_s is the density (cm^2) of spontaneous tracks and N_s is the number of spontaneous tracks counted; ρ_i is the density (cm^2) of induced tracks and N_i is the number of induced tracks counted; ρ_d is the density (cm^2) of tracks on the fluence monitor (CN5) and N_d is the number of tracks on the monitor; n is the number of grains counted; χ^2 is the Chi-squared probability (%). Zircon fission track ages (± 1σ) were determined using the Zeta method, and calculated using the computer program and equations in Brandon (1992). A Zeta factor of 344.49 ± 9.16 (± 1 se) is based on 9 determinations on standard samples from the Fish Canyon Tuff and Peach Springs Tuff. Glass monitors (CN5) placed at the top and bottom of the irradiation package were used to determine the fluence gradient. All samples were counted at 1250x using a dry 100x objective (10x oculars and 1.25x tube factor) on an Olympus BX60 microscope fitted with an automated stage and a Calcomp digitizing table.

Table 2: Binomial component ages of detrital zircon fission-track data, Baranof Schist

Sample	Etch (hr)	n	Range (Ma)	P1	P2	P3	P4	P5
WB13-06a	13.25	30	19.9-61.3	28.1 ± 3.3 42.7%	41.2 ± 2.05 57.3%	----	----	----
WB13-10a	24	30	22.6-61.3	35.2 ± 1.6 90.3%	59.0 ± 5.6 9.7%	----	----	----
WB13-12a	22	30	22.6-82.3	29.3 ± 2.85 37.5%	42.7 ± 3.0 62.5%	----	----	----
WB13-14a	13.25	30	20.4-69.3	27.0 ± 2.65 37.4%	39.9 ± 2.9 62.6%	----	----	----
WB13-16a	22	30	25.8-62.5	35.3 ± 2.25 78.1%	49.7 ± 7.8 21.9%	----	----	----
WB13-17a	24	30	26.1-63.6	30.4 ± 3.4 34.1%	42.2 ± 2.8 65.9%	----	----	----

Note: n = number of dated grains; Uncertainties are cited at 68% confidence interval (about ±1 SE; asymmetric errors are averaged). Zircon grains were dated using standard methods for FT dating using an external detector. Zircons were extracted using standard separation procedures. Fission-tracks were counted on an Olympus BX60 microscope fitted with an automated stage and Calcomp digitizing tablet. Total magnification was 1250x (100x objective, 10x oculars, 1.25 tube factor). A Zeta factor of 344.49 ± 9.16 (± 1 se) was as computed from 9 determinations on standard samples (Fish Canyon Tuff and Peach Springs Tuff). This table shows all binomial peak fitted ages using Binomfit 1.2.62 (Brandon, 1992).

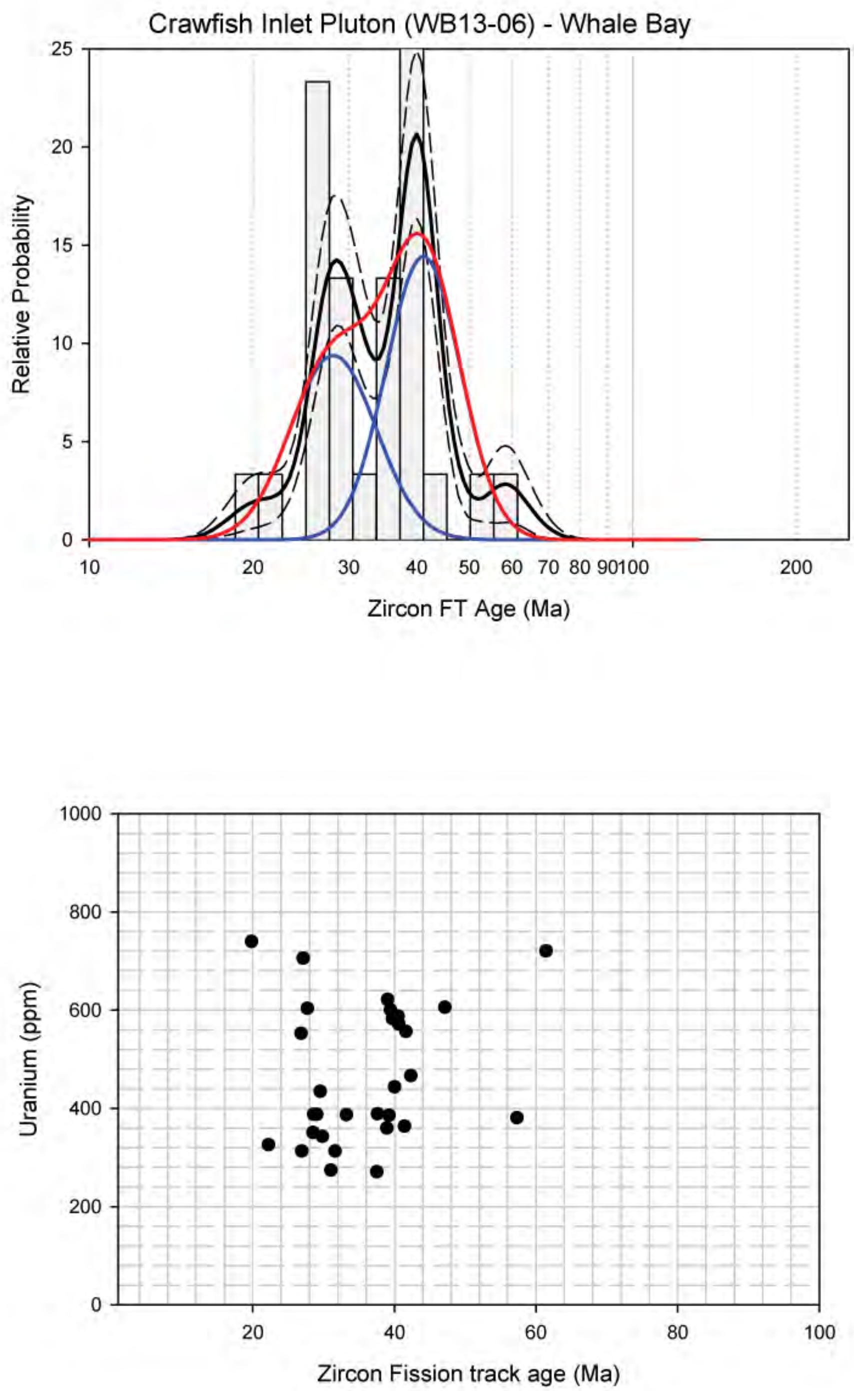


Figure 9. Grain-age distribution and uranium concentration plots for sample WB13-06 from the Crawfish Inlet pluton in Whale Bay.

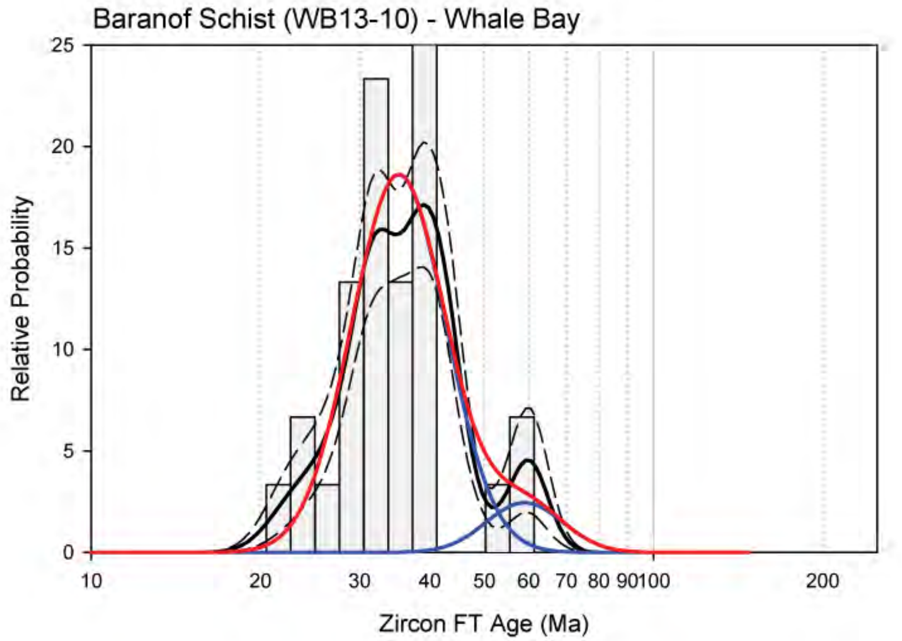


Figure 10. Grain-age distribution and uranium concentration plots for sample WB13-10 from the Baranof Schist in Whale Bay.

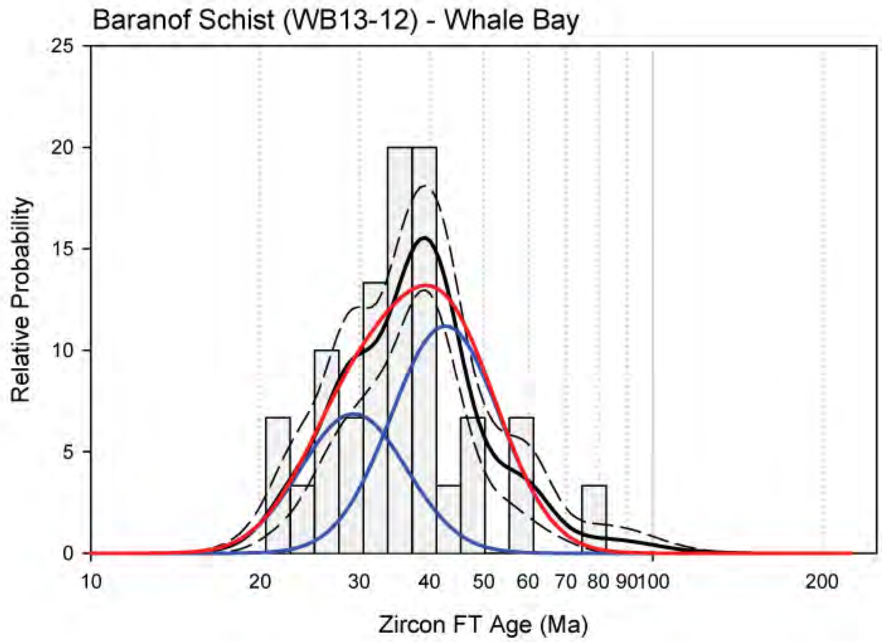
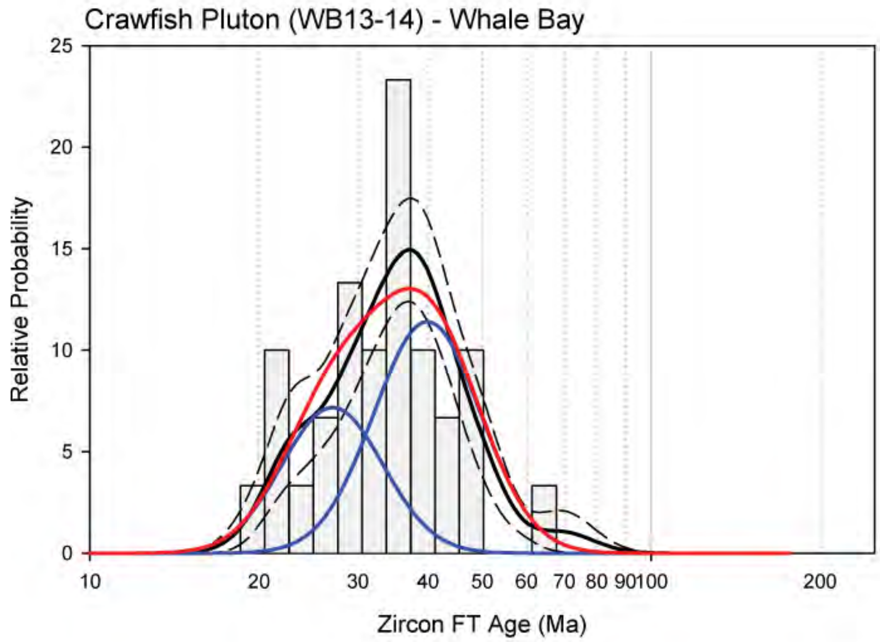


Figure 11. Grain-age distribution and uranium concentration plots for sample WB13-12 from the Baranof Schist in Whale Bay.



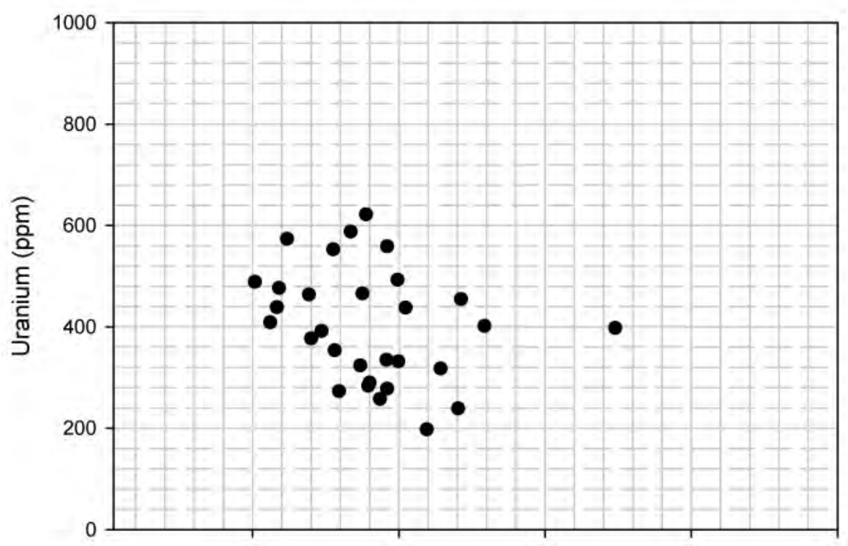


Figure 12. Grain-age distribution and uranium concentration plots for sample WB13-14 from the Crawfish Inlet pluton in Whale Bay.

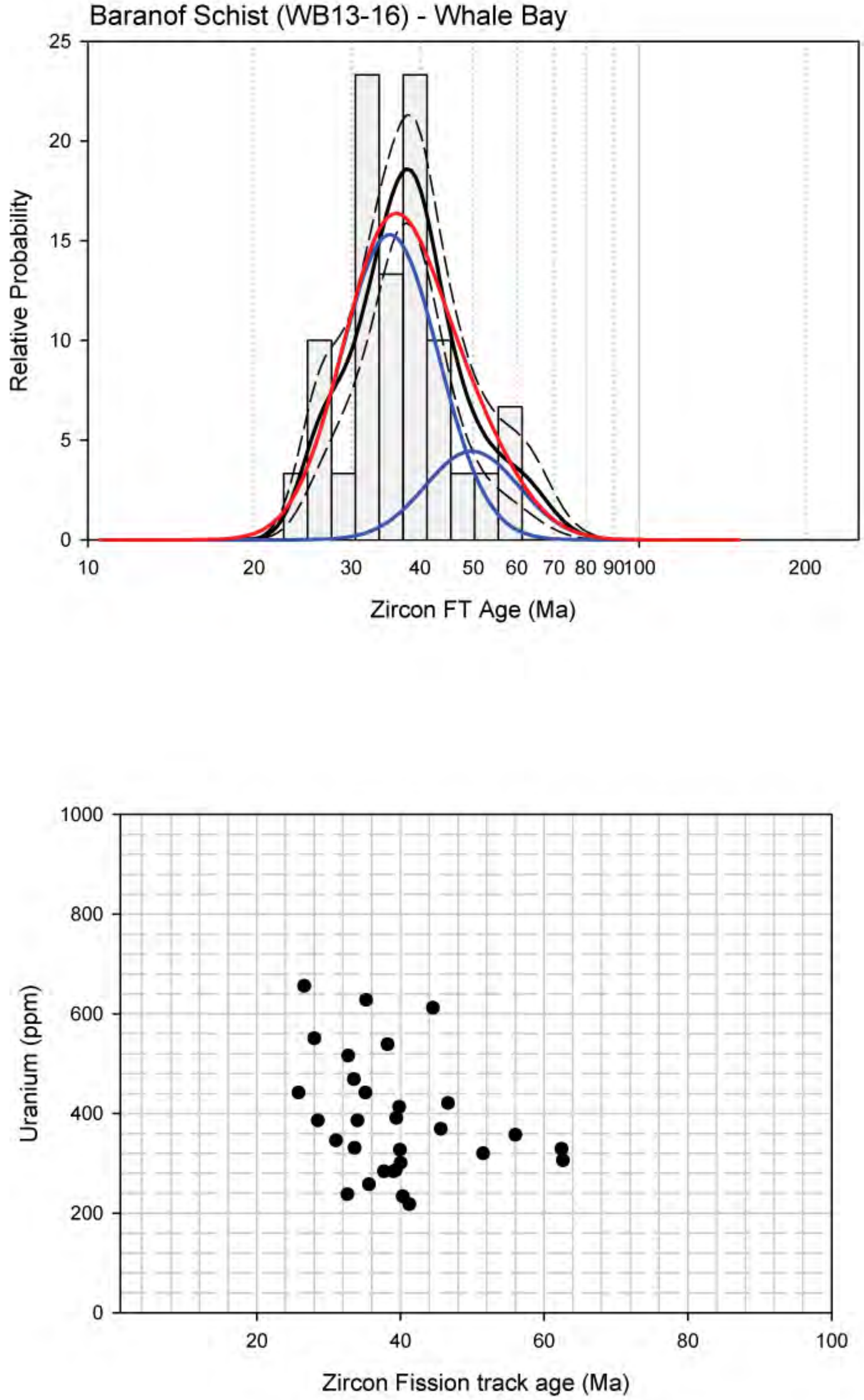


Figure 13. Grain-age distribution and uranium concentration plots for sample WB13-16 from the Baranof Schist in Whale Bay.

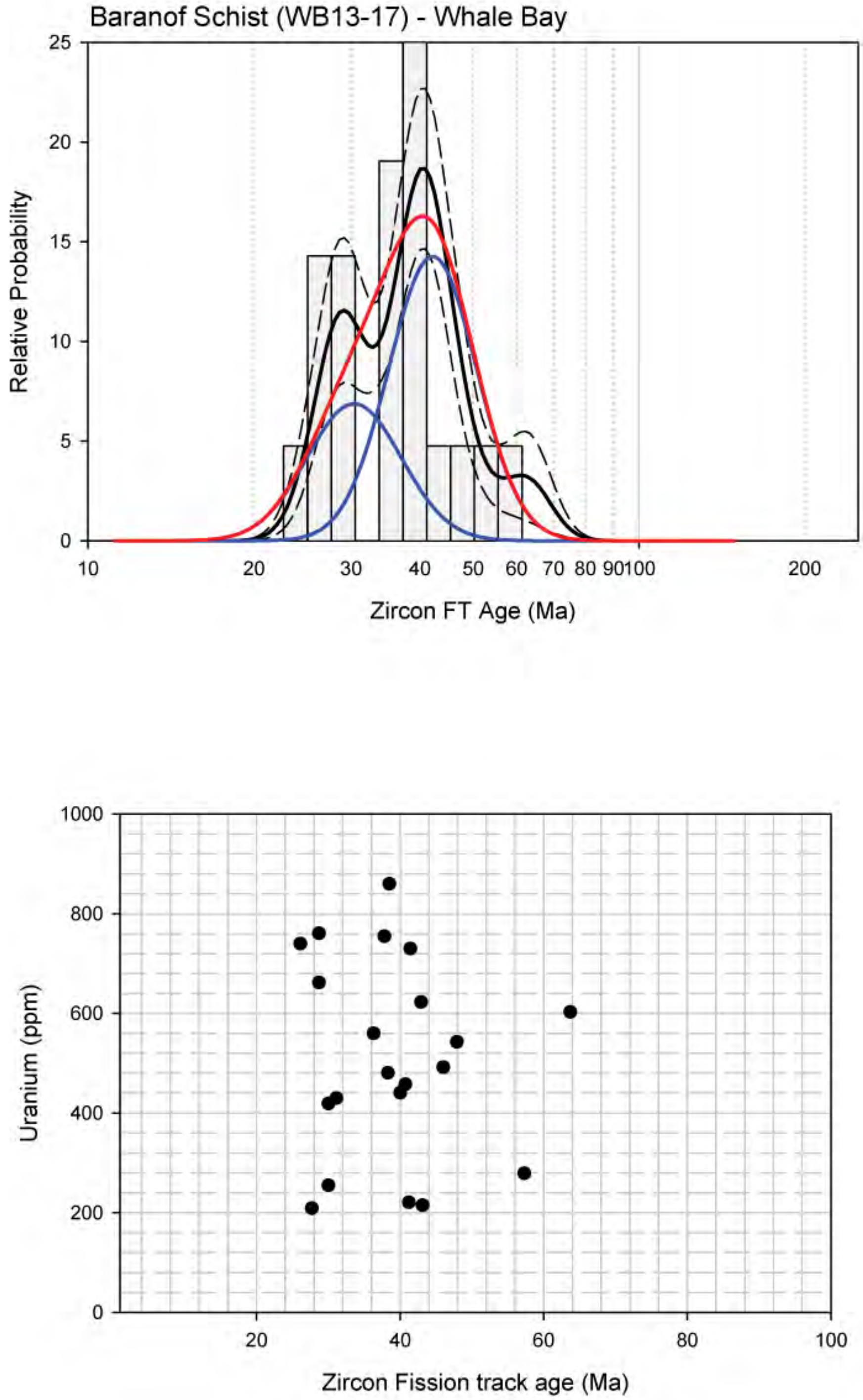


Figure 14. Grain-age distribution and uranium concentration plots for sample WB13-17 from the Baranof Schist in Whale Bay.

DISCUSSION

Cooling of the Baranof Schist

Few studies have been done on the Baranof Schist to determine its cooling rate after intrusion of the Crawfish Inlet pluton, and none have investigated cooling through zircon fission track dating. The Sitka Graywacke, and thus the Baranof Schist, was accreted in the Cretaceous to early Tertiary, as determined by U-Pb zircon dating (Haeussler et al. 2004; Rick et al., 2014). U-Pb dating on the zircons from strata in Whale Bay confirm this claim, as these strata have young populations of U-Pb ages of 63-75 Ma, constraining the deposition of protolith of the Baranof Schist to the Paleocene and Campanian-Maastrichtian (Rick et al., 2014). Over 10 Myr later, the Baranof Schist and the Sitka Graywacke were intruded by the Crawfish Inlet pluton between 47 and 52 Ma (Wackett et al., 2014). Based on estimations and cooling calculations of Zumsteg et al. (2003), the Baranof Schist is estimated to have reached temperatures of 575° to 755° C and pressures of 3.4 to 6.9 kbar at intrusion. The geothermal gradient in the area was elevated due to the intrusion, and the schist may actually have been as shallow as 10 km, as has been recognized in the Leech River Schist (Groome et al., 2003). The unit was metamorphosed and the heating reset the zircons so they show ages of cooling after intrusion, not cooling after crystallization. Any unreset samples would have depositional ages of 63 Ma or older, but were all reset as they have cooling ages of 32-38 Ma.

The cooling ages of the Baranof Schist are statistically indistinguishable. The similarity in all the cooling ages across the Whale Bay indicate that the rate of cooling was virtually the same across the transect. The samples do not young as they approach the pluton, which may have been expected considering that the samples closest to the pluton would have been hottest and taken longer to cool. Rather there is no trend to indicate any difference in cooling rates. These consistent initial cooling rates in the Baranof Schist 40-50 Ma were likely due to conduction, which may have later been followed by exhumation. If the samples had displayed significant differences in cooling ages, especially a pattern of younging in one direction, they would have indicated tilting or uneven exhumation of the unit, indicating different rates of exhumation and thus cooling.

Biotite K-Ar dating shows that cooling began directly after intrusion with ages of 48-43 Ma (summarized in Karl et al., 2014). Cooling ages from our samples in Whale Bay give young ages of 27-37 Ma (Table 1), indicating that most low-temperature cooling occurred well after intrusion. Cooling must have slowed down significantly if ZFT ages up show that from 42-27 Ma the unit was still in the process of cooling.

The cooling ages of the Baranof Schist of Whale Bay fit into the larger pattern of regional cooling of the eastern CPW. The cooling ages along this transect fall within those of previous studies looking at the Orca and Valdez Groups of the CPW. Milde (2011), Carlson (2012), Izykowski (2011), and Izykowski et al. (2011) all report an upper range of cooling ages of 48-52 Ma of the Orca and Valdez groups inferred to be caused by plutonism of the Sanak-Baranof plutonic belt. There is a lower cooling range of 37-40 Ma (Carlson, 2012; Milde, 2011) and a final set of very young ages of 25-30 and 31 reported by Carlson and Izykowski, respectively (2012, 2011). Samples from Whale Bay fit into the younger of the two age suites, which is consistent with the idea of plutons younging from west to east. Ages of the plutons young west to east along the Sanak-Baranof plutonic belt, and as a result, cooling ages are also younger, as reflected in this study and previous studies on the CPW.

Overdispersion

Half of the Baranof Schist samples from Whale Bay did not pass χ^2, indicating that there are heterogeneous populations causing overdispersion within the samples. The overdispersed samples typically have two main age populations. Most grains of the younger population cooled 35 Ma and the older population cooled 41.5 Ma. Combined, this feature of the data structure causes the pooled age of a sample to look older than the young cooling age, which likely has the most geologic significance. Using the χ^2 age of these overdispersed samples, we were able to take the age of the sample using only the younger ages, which represent the most recent thermal event. In almost all cases, the P1 and χ^2 ages are similar.

The overdispersion of the grains in the six samples is potentially due to the different retentiveness of the zircons (Garver et al., 2005). The difference in annealing temperatures of low retentive zircon (LRZ) and high retentive zircon (HRZ) can lead to partial annealing in grains and full annealing in others. If a population of grains contains a mixture of the two types, some grains will be completely reset, displaying young cooling ages (~30 Ma), while others are only partially reset, with ages slightly older than the young cooling ages but younger than deposition age (~45 Ma). In our samples, the young population of ZFT ages is from LRZs and the slightly older populations are from HRZs.

Overdispersed samples (HRZs and LRZs) and samples that passed χ^2 have a relationship indicating a noticeable cooling trend (Fig. 15). The closure temperature of HRZs (low- or zero-damage zircon) is constrained by laboratory experiments and field observations, and the effective closure rate is in part a function of cooling rate (and remnant radiation damage). For our purposes, 300°C is estimated, but the value could be as high as 350°C (see Rahn et al., 2004; Reiners and Brandon, 2006). The closure temperature of LRZs (damaged or partly damaged zircon) is primarily known from field settings (for examples see Brandon et al., 1998; Garver et al., 2005) and estimates vary between 200° and 250°, and perhaps as low as 180° (see discussion in Reiners and Brandon, 2006). For this plot, 220° is used as a midpoint between estimates, recognizing that some damage must have been removed in metamorphism. This plot is only an estimate of why these cooling ages vary significantly from sample to sample. A change in closure temperature changes the slope of the line (cooling rate), but in almost any scenario, the cooling rate is relatively low (<10°C/Myr). As plotted, the cooling rate is ~7°C/Myr.

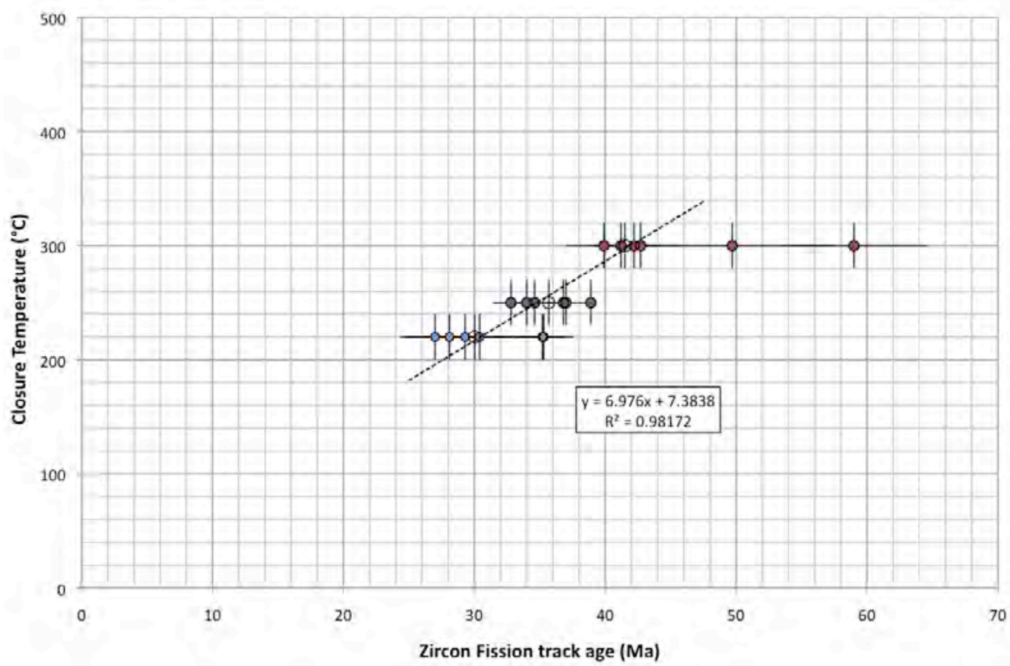


Figure 15. High- and low-retentive zircon closure temperatures in Whale Bay. LRZs in blue plot at 220º C and HRZs in red plot at 300º C. Samples that are not overdispersed plot at 250º C (Brandon et al., 1998; Rahn et al., 2004; Garver et al., 2005; Reiners and Brandon, 2006). The slope of the samples was calculated excluding the one LRZ and two HRZ outliers and produces a cooling rate of ~7º C/Myr.

Dike experiment

Samples WB13-02 and WB13-03 in Still Harbor (near the entrance to Whale Bay) produced ages of 34.6 ± 1.5 Ma and 32.8 ± 1.3 Ma, respectively, which are within the range of the other samples of Whale Bay, though slightly younger. The composition of these dikes is basaltic, which indicates that they are unrelated to the granitic intrusion of the Crawfish. These dikes were produced from a post-50 Ma metamorphic event that did not significantly heat up the Baranof Schist and reset the zircons again. It is likely that the dikes are Oligocene or older.

Two potential sources of the Still Harbor dikes are the Kano Intrusions and Admiralty Island metamorphism. The Kano Intrusions on the Haida Gwaii (Queen Charlotte) Islands occurred 38.9-26.8 Ma and produced monzodioritic and granodioritic dikes (Madsen et al., 2006). The time frame for this intrusive event matches that of the Still Harbor dikes, but the composition of the intrusions do not match up with the basaltic dikes. The Admiralty Island volcanics are ~35-20 Ma and produced the basaltic dikes of the Kootznahoo Formation, dated at 22 Ma (Ancuta, 2010). It is likely that the Still Harbor dikes are sourced from the Admiralty Island metamorphism, as they are compositionally similar and fit neatly into the time of intrusion.

The conditions under which these dikes were intruded are unknown. Because the zircons of this area display similar cooling ages to all other samples in Whale Bay, we know that they were all heated by the intrusion of the Crawfish Inlet pluton, which reset the zircons to display the subsequent cooling. If the Admiralty Island volcanics affected the Baranof Schist, they may have reheated the zircons of Whale Bay enough to provide a new cooling signature. The dikes could also have intruded the Baranof Schist at the same time or slightly after the intrusion of the Crawfish pluton. In this case, the schist would still be heated from the pluton so smaller dikes of lower temperatures would not be hot enough to reset the zircons a second time. Although we have no evidence to support either hypothesis in particular, we know for certain that the Still Harbor dikes had no annealing effect on the zircons of Whale Bay.

Correlation with the CMC and LRS

The Baranof Schist is a metamorphic unit of the CPW that has analogs elsewhere in the belt. Using data from previous studies of the Baranof Schist, we can form a cooling curve of the Baranof Schist and compare it to similar metamorphic complexes of the CPW (Groome et al., 2003; Zumsteg et al., 2003; Gasser et al., 2012; Karl et al., 2014). These thermochronology data allow us to see how particular units have cooled since intrusion. Because each thermochronologic method pertains to a specific temperature, we are able to look at the integrated Tt path.

The Chugach metamorphic complex (to the north and west) and the Leech River Schist (well to the south on Vancouver Island) are thought to have been contiguous with the Baranof Schist during the Eocene, exhibit similar cooling patterns (Fig. 16). The Baranof Schist was heated ~51 Ma and reached at least 720º C as determined by Zumsteg et al. (2003). After intrusion, the unit began to cool rapidly at a rate of approximately 120 ºC/Myr. After about six Myr, the cooling rates decrease significantly, to about 7 ºC/Myr. A similar pattern is evident in the CMC, which was intruded ~52-55 Ma and cooled at the same rate as the Baranof Schist at 7 ºC/Myr (Gasser et al., 2012). The individual schist and gneiss zones of the CMC cooled at different rates, indicating that the units were possibly of different thicknesses and thus metamorphosed at different depths, or the geothermal gradient shifted to change the temperatures at each depth. Well to the south, the Leech River Schist was intruded ca. 51 Ma by the Walker Creek intrusions and then cooled rapidly throughout the Eocene. For about the first 6 Myr of cooling, the Leech River Schist cooled at the same rate as the Baranof Schist and the CMC (~120° C/Myr), but after the other units began to slow cooling, the Leech River Schist was exhumed to the surface. This consistent rapid rate of cooling is likely due to the exhumation of the Leech River Schist when it collided with the Crescent terrane (Groome et al., 2003). At 35 Ma the Leech River Schist was completely exhumed, at which point it was overlain by the Oligocene Carmanah Group (Groome et al., 2003).

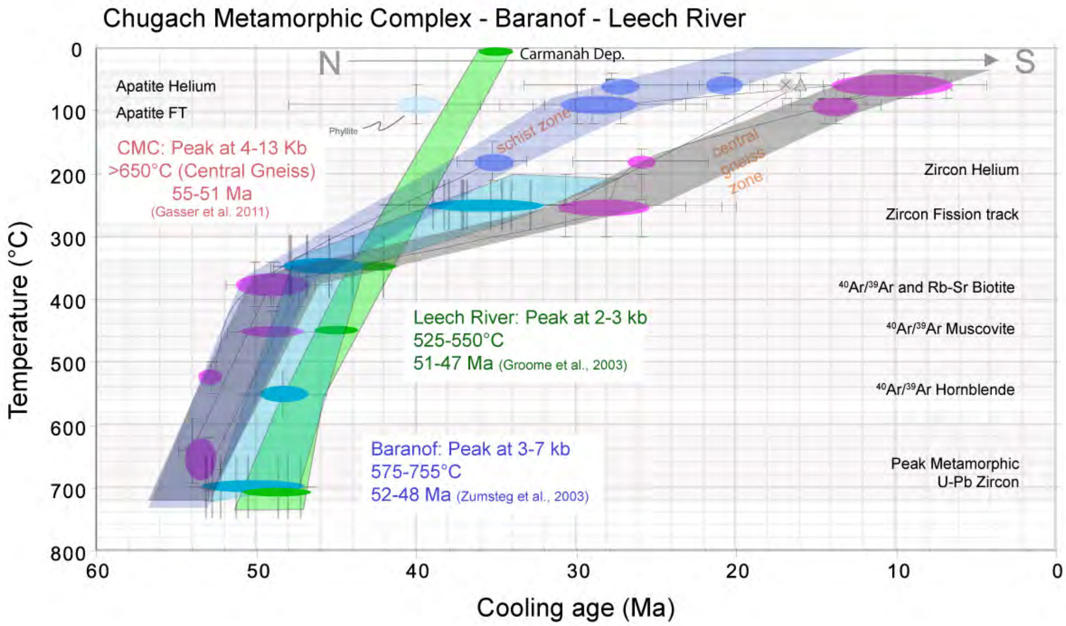


Figure 16. Cooling curves of the Chugach metamorphic complex, Baranof Schist, and Leech River schist. Each thermochronologic technique constrains a particular temperature range of the cooling curve. The CMC was heated first and began cooling 52-55 Ma, followed by the Baranof Schist, which began cooling 50-51 Ma, and finally the Leech River Schist, which began cooling 49-50 Ma. The cooling curves indicate that the CMC and Baranof Schist have similar cooling histories and were likely translated north together while the Leech River Schist has a different history and remained in place (data from Groome et al., 2003; Zumsteg et al., 2003; Gasser et al., 2012)

Tectonic model

Metamorphism and subsequent cooling of the three units originally located along the margin is potentially related to the migration of a slab window, which heated each unit sequentially (Scharman and Pavlis, 2012; Zumsteg et al., 2003). During the Eocene, the North American-Kula-Farallon triple junction was migrating rapidly along the continental margin through strike-slip motion and allowed for the formation of a slab window beneath the accretionary complex (Scharman and Pavlis, 2012). The triple junction was moving southward relative to these units, and thus so was the potential slab window (Scharman and Pavlis, 2012; Zumsteg et al., 2003).

This hypothesis is consistent with the Kula-Pacific model, which allows for southward migration of the triple junction and thus the slab window (Pavlis and Sisson 2003). From 54-48 Ma the triple junction migrated southward within the Chugach metamorphic complex, which would correlate with the following movement and metamorphism through the Baranof Schist and Leech River Complex (Pavlis and Sission, 2003). After metamorphism of the three units, the triple junction may have rapidly jumped to the north or migrated rapidly northwest of the CMC during the plate reorganization of the Eocene (Pavlis and Sisson, 2003).

Terrane translation

The significant difference between the exhumation rates of the CMC and Baranof Schist and the Leech River Schist indicate that some geologic event caused thermal evolution to differ between the units. Because the CMC and Baranof Schist show a similar cooling pattern, we can assume that they exhumed at the same rate due to a shared tectonic process that differed by only a few million years. The Leech River Schist, however, shares this early history of heating, but was isolated from the other two units through collision and underthrusting by the Crescent Terrane (Groome et al., 2003). This event caused the Leech River Schist to be firmly attached to the stationary North American plate and become pinned in place (Groome et al., 2003; Madsen et al., 2006). Paleomagnetic studies show no evidence for northward translation of the Crescent terrane, and thus it is likely that the Leech River Schist is currently located about where it was intruded by the Walker Creek magmatism (Groome et al., 2003).

While the Leech River Schist did not translate northward, this was not the case for the rest of the belt if they were originally contiguous (Cowan, 2003). The question that remains is how the cooling of the Baranof Schist and CMC slowed following the Eocene. The two units could have been buried and then metamorphosed by the passing of the slab window, then remained buried and stayed at depth instead of being exhumed immediately as the LRS was. Reduced rates of erosion and uplift and an elevated geothermal gradient are potential explanations for the cooling patterns of the Baranof Schist and CMC. Long-term and continuous rates of rapid erosion establish an elevated geothermal gradient with shallow isotherms, which lead to faster cooling of rocks (Reiners and Brandon, 2006). If the rocks of the CPW in the Eocene had very rapid cooling rates (i.e. cooling 120º C/Myr) directly after intrusion, the local geothermal gradient would have been high but constantly falling. After about 6 Myr in the cooling rate falls substantially (7º C/Myr) and the isotherm is no longer falling as rapidly, allowing the rocks to cool but at a much slower rate. In the Baranof and CMC, the isotherm may have not fallen enough to reach the closure temperature, not allowing zircons in the rocks to accumulate damage until ~25-30 Ma. The final process that allowed the rocks to cool at this point in time is erosion that took off the top of the rocks and allowed for the final cooling of the CMC and Baranof Schist.

CONCLUSIONS

The Baranof Schist, Chugach metamorphic complex, and Leech River Schist were at one point a contiguous belt located at ~48º-50º N and experienced heating consecutively due to migration of a slab window of the Eocene triple junction. After metamorphism, the Baranof Schist and CMC were translated northward by dextral strike-slip motion of the Border Ranges and Queen Charlotte-Fairweather faults while the Leech River Schist remained in place due to collision.

Zircon fission track ages reveal cooling ages of the Baranof Schist in Whale Bay of Baranof Island. The cooling of the rocks in the transect was simultaneous, with ages from 27-39 Ma, indicating the entire unit cooled at the same rate without tilting or uneven exhumation. The cooling pattern is similar between Baranof Schist and CMC, indicating that they have a similar tectonic and exhumation history, unlike that of the Leech River Schist, which cools at a consistent rate throughout its entire cooling history. The cooling patterns indicate that after metamorphism by the slab window, all three units began cooling similarly, but then the Leech River Schist continued to cool while the Baranof Schist and CMC slowed down significantly. The LRS exhumed rapidly due to collision with the Crescent terrane and the Baranof Schist and CMC slowed down due to slowed erosion rates and a shallow geothermal gradient.

While the cooling pattern of the Baranof Schist and CMC seem to indicate an elevated geothermal gradient and slow rates of erosion following intrusion, data from this study is not sufficient enough to confidently determine how or at what time the Baranof Schist was completely exhumed. Similarly, cooling ages from this study do not provide direct evidence to either support or dispute the translation hypothesis, but do bring to light the cooling pattern of the schist. More low-temperature thermochronology data is needed to complete the Baranof Schist cooling curve to determine when it was completely exhumed and make conclusions about its tectonic history.

REFERENCES

Amato, J.M., and Pavlis, T.L., 2010. Detrital zircon ages from the Chugach terrane, southern Alaska, reveal multiple episodes of accretion and erosion in a subduction complex. Geology, v. 38, no. 5, pp. 459–462.

Ancuta, L., 2010. Fission track ages of detrital zircon from the Paleogene Kootznahoo Formation, SE Alaska. Annual Keck Symposium, v. 23, pp. 7-15.

Bernet, M., and Garver, J.I., 2005. Fission-track analysis of detrital zircon. Reviews in Mineralogy and Geochemistry, v. 58, pp. 205-238.

Bradley, D., Kusky, T., Haeussler, P., Goldfarb, R., Miller, M., Dumoulin, J., Nelson, S.W., and Karl, S., 2003. Geologic signature of early Tertiary ridge subduction in Alaska, in Sisson, VB., Roeske, S.M., and Pavlis, T.L., (eds.), Geology of a transpressional orogen developed during ridge-trench interaction along the North Pacific margin. Boulder, Colorado, Geological Society of America Special Paper 371, pp. 19-49.

Brandon M.T., Vance J.A., 1992. New statistical methods for analysis of fission track grain-age distributions with applications to detrital zircon ages from the Olympic subduction complex, western Washington State. Am. J. Sci. vol. 292. pp. 565-636.

Brandon, M.T., Roden-Tice, M.R., and Garver, J.I., 1998. Late Cenozoic exhumation of the Cascadia accretionary wedge in the Olympic Mountains, northwest Washington State. Geological Society of America Bulletin, v. 100, pp. 985-1009.

Carlson, B.M., 2012. Analysis of detrital zircon fission track ages of the Upper Cretaceous Valdez Group and Paleogene Orca Group in Western Prince William Sound, Alaska. Unpublished BSc thesis, Union College, Schenectady, NY, 123 pp.

Cowan, D.S., 2003. Revisiting the Baranof-Leech River hypothesis for early Tertiary coastwise transport of the Chugach-Prince William terrane. Earth and Planetary Science Letters, v. 213, pp. 463-475.

DeLuca, M.J., 2013. Thermal Evolution and Provenance Revealed Through Detrital Zircon Fission Track Dating of the Upper Cretaceous strata on Nagai and Kodiak Islands, Alaska. Unpublished BSc thesis, Union College, Schenectady, NY, 106 pp.

Farris, D. W., & Paterson, S. R., 2009. Subduction of a segmented ridge along a curved continental margin: Variations between the western and eastern Sanak–Baranof belt, southern Alaska. Tectonophysics, v. 464, no. 1, pp. 100-117.

Garver, J.I., Reiners, P.W., Walker, L.J., Ramage, J.M., and Perry, S. E., 2005. Implications for timing of Andean uplift from thermal resetting of radiation-damaged zircon in the Cordillera Huayhuash, Northern Peru. Journal of Geology, v. 113, pp. 117-138.

Gasser, D., Bruand, E., Stüwe, K., Foster, D. A., Schuster, R., Fügenschuh, B., & Pavlis, T., 2011. Formation of a metamorphic complex along an obliquely convergent margin: Structural and thermochronological evolution of the Chugach Metamorphic Complex, southern Alaska. Tectonics, v. 30, no. 2.

Groome, W. G., Thorkelson, D. J., Friedman, R. M., Mortensen, J. K., Massey, N. W., Marshall, D. D., & Layer, P. W., 2003. Magmatic and tectonic history of the Leech River Complex, Vancouver Island, British Columbia: Evidence for ridge- trench intersection and accretion of the Crescent Terrane. Special Papers-Geological Society Of America, pp. 327-354.

Haeussler, P.J., Bradley, D.C., Wells, R.E. & Miller, M.L., 2003. Life and death of the Resurrection Plate; evidence for its existence and subduction in the northeastern Pacific in Paleocene-Eocene time. Geological Society of America Bulletin, v. 115, no. 7, pp. 867-880.

Haeussler, P.J., Gehrels, G.E., Karl, S.M., 2004. Constraints on the Age and Provenance of the Chugach Accretionary Complex from Detrital Zircons in the Sitka Graywacke near Sitka, Alaska. U.S. Geological Survey Professional Paper 1709–F, pp. 1-24.

Izykowski, T.M., 2011. Detrital zircon fission track ages of the Paleogene Orca Group of Eastern Prince William Sound, near Cordova, Alaska. Unpublished BSc thesis, Union College, Schenectady, NY. 97 pp.

Izykowski, T.M., Milde, E.R., and Garver, J.I., 2011. Fission-track dating of reset detrital zircon from the Vladez Group (Thompson Pass) and Orca Group (Cordova): Implications for the thermal evolution of the Chugach-Prince William terrane, Alaska. Geological Society of America Abstracts with Programs, v. 43, n. 4, p. 81

Karl, S.M., Haeussler, P.J., Zumsteg, C.L., Himmelberg, G.R., Layer, P.W., Friedman, R.F., Roeske, S.M., Snee, L.W., 2014. Geologic map of Baranof Island, Southeast Alaska. U.S. Geological Survey Investigations Map, 14-xxx (in press).

Loney, R.A., Brew, D.A., Muffler, L.J.P., 1975. Reconnaissance Geology of Chichagof, Baranof, and Kruzof Islands, Southeastern Alaska. Geological Survey Professional Paper 792, pp. 1-94.

Loney, R.A., Brew, D.A., 1987. Regional thermal metamorphism and deformation of the Sitka Graywacke, southern Baranof Island, southeastern Alaska. USGS Bull. 1779, pp. 1-17.

Madsen, J.K., Thorkelson, D.J., Friedman, R.M., Marshall, D.D., 2006. Ceneozoic to recent plate configurations in the Pacific Basin: Ridge subduction and slab window magmatism in western North America. Geosphere, vol. 2, pp.11-34.

Milde, E.R., 2011. Fission track ages of detrital zircon for the Campanian-Maastrichtian Valdez Group of the Chugach terrane, Richardson Highway, Valdez, southeast Alaska. Unpublished BSc thesis, Union College, Schenectady, NY, 78 pp.

Pavlis, T. L., & Sisson, V. B., 2003. Development of a subhorizontal decoupling horizon in a transpressional system, Chugach metamorphic complex, Alaska: Evidence for rheological stratification of the crust. Special Papers–Geological Society of America, pp. 191-216.

Plafker, G., Moore, J.C. & Winkler, G.R., 1994. Geology of the Southern Alaska margin in the geology of Alaska, eds. G. Plafker & H.C. Berg, Geological Society of America, Boulder, CO, United States (USA), pp. 389-449.

Reiners P.W., and Brandon, M.T., 2006. Using thermochronology to understand orogenic erosion. Annual Review of Earth and Planetary Science, v. 34, pp. 419-466.

Rick, B.J., Frett, B.K., Davidson, C.M., and Garver, J.I., 2014. U/Pb dating of detrital zircon from Seward and Baranof Island provides despositional links across the Chugach-Prince William terrane and southeastern Alaska. Cordilleran Tectonics Workshop, University of British Columbia – Okanagan, Abstracts with program, pp. 35-36.

Roeske, S. M., Snee, L. W., & Pavlis, T. L., 2003. Dextral-slip reactivation of an arc-forearc boundary during Late Cretaceous-Early Eocene oblique convergence in the northern Cordillera. Special Papers–Geological Society of America, pp. 141-170.

Scharman, M. R. and Pavlis, T. L., 2012. Kinematics of the Chugach metamorphic complex, southern Alaska: Plate geometry in the north Pacific margin during the Late Cretaceous to Eocene. Tectonics, v. 31, no. 4.

Wackett, A.A., Smith, D.R., Roig, C.I., Cavosie, A.J., Davidson, C.M., Garver, J.I., Valley, J.W., 2014. Geochemistry and Geochronology of the Crawfish Inlet Pluton, Baranof Island, Alaska. Cordilleran Tectonics Workshop, University of British Columbia – Okanagan, Abstracts with program, pp. 43-45.

Zumsteg, C.L., Himmelberg, G.R., Karl, S.M., Haeussler, P.J., 2003. Metamorphism within the Chugach accretionary complex on southern Barnoff Island, southeastern Alaska. In: Sisson, V.B., Roeske, S.M., Pavlis, T.L. (Eds.). Geology of a Transpressional Orogen Developed During Ridge–Trench Interaction Along the North Pacific Margin. GSA Special Paper, v. 371, pp. 253–268.

APPENDIX A:

Zeta Calibration Data

MEAN ZETA CALCULATION

TITLE:

OPERATOR NAME: Kate Kaminski

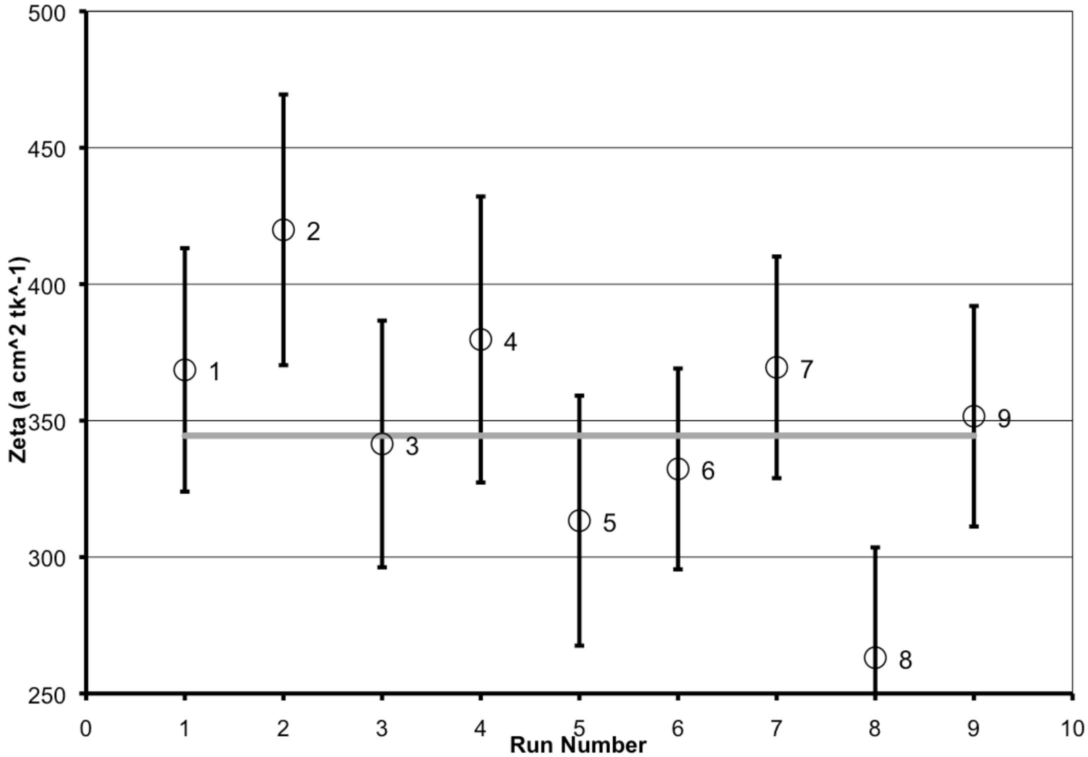
DATE: October 2012 to January 2014

RESULTS

Weighted Mean Zeta =		**344.49**
	±1SE =	**9.16**
	±2SE =	**18.32**

DATA

Irradiation			Age Standard	Measured Zeta (a cm^2 tk^{-1})		
Run Date	**Run Name**	**Position Number**	**Name**	**Zeta Value**	**Count SE**	**Total SE**
12-Oct	U50Z	40	FCT	368.6	22.3	23.2
12-Oct	U50Z	42	FCT	419.92	24.8	26
13-Oct	U50Z	38	PST	341.46	22.6	22.7
13-Oct	U53Z	27	FCT	379.74	26.2	27.1
13-Oct	U53Z	30	PST	313.34	22.9	23
13-Oct	U50Z	42	FCT	332.31	18.4	19.6
13-Oct	U50Z	40	FCT	369.52	20.3	21.3
13-Nov	U53Z	29	PST	263.14	20.2	20.2
14-Jan	U53Z	26	FCT	351.61	20.2	21.2


500
450
400
350
300
250
Zeta (a cm^2 tk^-1)
0
1
2
3
4
5
6
7
8
9
10
Run Number
1
2
3
4
5
6
7
8
9

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FCT-3, U50Z-40, Fish Canyon Tuff, Oct 18

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90   0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2):   2.850E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%):   1.65
SIZE OF COUNTING SQUARE (CM^2):   6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.030E+07	(95)	1.409E+07	(130)	14	268.50	36.5	36.8
2	1.897E+06	(25)	3.945E+06	(52)	20	408.12	99.6	99.8
3	5.185E+06	(41)	1.125E+07	(89)	12	425.93	80.7	81.1
4	3.414E+06	(18)	1.176E+07	(62)	8	675.85	181.3	181.7
5	5.918E+06	(39)	1.426E+07	(94)	10	472.93	90.4	90.8
6	4.552E+06	(36)	7.967E+06	(63)	12	343.37	72.0	72.2
7	7.208E+06	(57)	1.189E+07	(94)	12	323.58	54.6	54.9
8	5.216E+06	(55)	9.674E+06	(102)	16	363.89	61.2	61.5
9	7.777E+06	(41)	1.404E+07	(74)	8	354.14	69.2	69.5
10	7.756E+06	(46)	1.534E+07	(91)	9	388.16	70.5	70.9
POOLED	5.681E+06	(453)	1.067E+07	(851)	121	368.60	22.3	23.2
MEAN ZETA (using grain ratios)						380.70	28.2	29.0

CHI-SQUARED PROBABILITY (%):   11.6

MEAN (RhoS/RhoI) +/- 1 SE: 0.515 +/- 0.0373

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FCT-5, U50Z-42, Fish Canyon Tuff, Oct 18 2012

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.823E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.71
SIZE OF COUNTING SQUARE (CM^2): 6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	3.878E+06	(46)	9.020E+06	(107)	18	460.78	81.6	82.0
2	6.449E+06	(34)	1.328E+07	(70)	8	407.83	85.5	85.9
3	6.196E+06	(49)	1.163E+07	(92)	12	371.92	66.1	66.4
4	5.159E+06	(34)	1.123E+07	(74)	10	431.14	89.6	90.0
5	2.630E+06	(26)	2.630E+06	(26)	15	198.09	55.0	55.2
6	6.449E+06	(68)	1.252E+07	(132)	16	384.53	57.8	58.2
7	3.204E+06	(38)	7.924E+06	(94)	18	490.01	94.6	95.0
8	5.438E+06	(43)	1.163E+07	(92)	12	423.82	78.6	79.0
9	5.817E+06	(46)	1.353E+07	(107)	12	460.78	81.6	82.0
10	6.196E+06	(49)	1.378E+07	(109)	12	440.65	76.2	76.6
11	2.630E+06	(26)	7.081E+06	(70)	15	533.32	122.8	123.2
POOLED	4.706E+06	(459)	9.976E+06	(973)	148	419.92	24.8	26.0
MEAN ZETA (using grain ratios)						392.94	40.7	41.3

CHI-SQUARED PROBABILITY (%): 36.4

MEAN (RhoS/RhoI) +/- 1 SE: 0.504 +/- 0.0515

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PST_2,U50z_38, Kaminski 10 october 2013

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 18.51 0.10
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.921E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.12
SIZE OF COUNTING SQUARE (CM^2): 6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	3.541E+06	(28)	1.100E+07	(87)	12	394.36	85.8	85.8
2	3.685E+06	(34)	8.780E+06	(81)	14	302.37	61.9	61.9
3	3.920E+06	(31)	8.599E+06	(68)	12	278.40	60.4	60.4
4	3.509E+06	(37)	7.398E+06	(78)	16	267.56	53.5	53.5
5	4.552E+06	(36)	1.328E+07	(105)	12	370.18	71.6	71.6
6	3.642E+06	(24)	1.093E+07	(72)	10	380.76	89.8	89.9
7	3.136E+06	(31)	9.105E+06	(90)	15	368.48	76.8	76.9
8	4.679E+06	(37)	9.737E+06	(77)	12	264.13	52.9	52.9
9	4.227E+06	(39)	1.333E+07	(123)	14	400.28	73.7	73.7
10	3.288E+06	(26)	1.113E+07	(88)	12	429.57	96.0	96.0
POOLED	3.800E+06	(323)	1.022E+07	(869)	129	341.46	22.6	22.7
MEAN ZETA (using grain ratios)						335.28	20.3	20.4

CHI-SQUARED PROBABILITY (%): 61.9

MEAN (RhoS/RhoI) +/- 1 SE: 0.379 +/- 0.0225

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AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.707E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.54
SIZE OF COUNTING SQUARE (CM^2): 6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	4.426E+06	(35)	1.075E+07	(85)	12	501.69	101.1	101.5
2	3.699E+06	(39)	8.061E+06	(85)	16	450.24	87.4	87.7
3	5.817E+06	(46)	1.024E+07	(81)	12	363.76	67.4	67.7
4	7.587E+06	(45)	1.130E+07	(67)	9	307.57	59.5	59.7
5	5.058E+06	(20)	7.840E+06	(31)	6	320.20	92.0	92.1
6	4.805E+06	(19)	7.334E+06	(29)	6	315.30	93.2	93.4
7	4.679E+06	(37)	9.863E+06	(78)	12	435.49	87.2	87.5
8	5.766E+06	(38)	1.077E+07	(71)	10	385.98	77.8	78.1
9	3.288E+06	(26)	4.805E+06	(38)	12	301.92	77.0	77.2
10	4.426E+06	(35)	7.587E+06	(60)	12	354.14	75.5	75.8
POOLED	4.822E+06	(340)	8.864E+06	(625)	107	379.74	26.2	27.1
MEAN ZETA (using grain ratios)						363.21	20.3	21.3

CHI-SQUARED PROBABILITY (%): 72.8

MEAN (RhoS/RhoI) +/- 1 SE: 0.569 +/- 0.0306

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PST_1,U53Z_30, Kaminski 24 october 2013

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 18.51   0.10
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2):   2.702E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%):   1.54
SIZE OF COUNTING SQUARE (CM^2):   6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	4.957E+06	(49)	1.113E+07	(110)	15	308.01	53.1	53.1
2	3.035E+06	(24)	9.231E+06	(73)	12	417.34	98.4	98.4
3	2.731E+06	(18)	1.047E+07	(69)	10	525.96	139.4	139.5
4	2.630E+06	(26)	3.844E+06	(38)	15	200.53	51.1	51.1
5	3.035E+06	(18)	7.924E+06	(47)	9	358.26	99.5	99.5
6	3.642E+06	(24)	7.739E+06	(51)	10	291.56	72.3	72.3
7	4.299E+06	(34)	9.990E+06	(79)	12	318.80	65.6	65.6
8	4.047E+06	(40)	8.801E+06	(87)	15	298.42	57.2	57.2
9	3.143E+06	(29)	5.961E+06	(55)	14	260.22	59.9	59.9
10	3.372E+06	(20)	5.901E+06	(35)	9	240.11	67.4	67.4
POOLED	3.537E+06	(282)	8.076E+06	(644)	121	313.34	22.9	23.0
MEAN ZETA (using grain ratios)						300.78	25.6	25.6

CHI-SQUARED PROBABILITY (%):   31.1

MEAN (RhoS/RhoI) +/- 1 SE: 0.456 +/- 0.0382

```
=================Zfactor Program  v. 1.2  (Brandon 3/18/95)=================
DATE/TIME: 10-20-2013/16:33:30  FILENAME:
C:\DOCUME~1\JOHNGA~1\DESKTOP\FTFOLD~1\KATE\STANDA~1\FC5_50X.FTZ
FCT-5, U50Z-42, Fish Canyon Tuff, Oct 20 2013

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD:   27.90     0.50
  TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2):    2.871E+05
   RELATIVE STANDARD ERROR FOR GLASS DENSITY (%):    1.19
                  SIZE OF COUNTING SQUARE (CM^2):    6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------
Grain    RhoS     (Ns)    RhoI      (Ni)  Squares   Zeta  Grain-only  Total
 no.   (cm^-2)           (cm^-2)                  (yr cm^2)    SE       SE
   1   1.017E+07 ( 67)   1.669E+07 (110)     10     319.79    49.7     50.0
   2   8.093E+06 ( 64)   1.454E+07 (115)     12     349.99    54.7     55.1
   3   9.105E+06 ( 48)   1.783E+07 ( 94)      8     381.44    67.8     68.2
   4   6.070E+06 ( 48)   1.012E+07 ( 80)     12     324.63    59.4     59.7
   5   4.363E+06 ( 46)   7.872E+06 ( 83)     16     351.45    64.7     65.0
   6   6.196E+06 ( 49)   1.100E+07 ( 87)     12     345.83    61.9     62.2
   7   7.081E+06 ( 56)   1.176E+07 ( 93)     12     323.47    54.8     55.2
   8   8.915E+06 ( 47)   1.555E+07 ( 82)      8     339.83    62.3     62.6
   9   8.725E+06 ( 69)   1.012E+07 ( 80)     12     225.83    37.2     37.4
  10   5.690E+06 ( 30)   1.328E+07 ( 70)      8     454.48    99.3     99.7

POOLED 7.229E+06( 524)   1.233E+07( 894)    110     332.31    18.7     19.6
MEAN ZETA (using grain ratios)                      332.38    20.3     21.1

CHI-SQUARED PROBABILITY (%):   47.0

MEAN (RhoS/RhoI) +/- 1 SE:      0.586  +/-  0.0350
```

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 10-17-2013/12:02:07 FILENAME:
C:\DOCUME~1\JOHNGA~1\DESKTOP\FTFOLD~1\KATE\STANDA~1\FC3_50X.FTZ
FCT-3, U50Z-40, Fish Canyon Tuff, Oct 10 2013

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.856E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.15
SIZE OF COUNTING SQUARE (CM^2): 6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	8.498E+06	(56)	1.381E+07	(91)	10	318.18	54.2	54.5
2	7.840E+06	(62)	1.454E+07	(115)	12	363.18	57.4	57.7
3	5.058E+06	(40)	1.012E+07	(80)	12	391.60	76.0	76.3
4	9.358E+06	(74)	1.416E+07	(112)	12	296.35	44.5	44.8
5	5.094E+06	(47)	1.192E+07	(110)	14	458.26	80.0	80.5
6	8.093E+06	(32)	1.366E+07	(54)	6	330.42	73.8	74.0
7	5.311E+06	(21)	6.829E+06	(27)	6	251.74	73.3	73.4
8	7.334E+06	(58)	1.252E+07	(99)	12	334.21	55.4	55.7
9	7.132E+06	(47)	1.608E+07	(106)	10	441.60	77.6	78.0
10	4.856E+06	(32)	1.168E+07	(77)	10	471.15	99.2	99.6
11	7.967E+06	(63)	1.682E+07	(133)	12	413.36	63.4	63.8
POOLED	6.959E+06	(532)	1.313E+07	(1004)	116	369.52	20.3	21.3
MEAN ZETA (using grain ratios)						357.10	22.3	23.2

CHI-SQUARED PROBABILITY (%): 45.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.548 +/- 0.0336

```
=================Zfactor Program  v. 1.2  (Brandon 3/18/95)=================
DATE/TIME: 11-07-2013/13:06:49  FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\STANDA~1\PS2_53Z.FTZ
PST_2,U53Z_29, Kaminski 3 November 2013

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD:   18.51     0.10
  TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2):    2.703E+05
   RELATIVE STANDARD ERROR FOR GLASS DENSITY (%):    1.54
                  SIZE OF COUNTING SQUARE (CM^2):    6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------
Grain    RhoS     (Ns)    RhoI      (Ni)  Squares   Zeta  Grain-only  Total
 no.   (cm^-2)          (cm^-2)                 (yr cm^2)    SE        SE
   1   3.414E+06 ( 27)  6.323E+06 ( 50)     12     253.99    60.8      60.8
   2   3.414E+06 ( 27)  8.093E+06 ( 64)     12     325.11    74.8      74.8
   3   4.552E+06 ( 27)  6.744E+06 ( 40)      9     203.19    50.7      50.7
   4   3.541E+06 ( 28)  7.840E+06 ( 62)     12     303.70    69.3      69.3
   5   2.529E+06 ( 20)  6.070E+06 ( 48)     12     329.17    87.8      87.8
   6   3.035E+06 ( 24)  5.185E+06 ( 41)     12     234.31    60.3      60.3
   7   3.035E+06 ( 24)  6.196E+06 ( 49)     12     280.03    69.9      69.9
   8   3.414E+06 ( 36)  5.121E+06 ( 54)     16     205.73    44.4      44.4
   9   3.161E+06 ( 25)  5.690E+06 ( 45)     12     246.88    61.7      61.7
  10   3.468E+06 ( 32)  7.045E+06 ( 65)     14     278.60    60.3      60.3

POOLED 3.331E+06( 270)  6.391E+06( 518)    123     263.14    20.2      20.2
MEAN ZETA (using grain ratios)                     259.04    14.9      14.9

CHI-SQUARED PROBABILITY (%):   85.3

MEAN (RhoS/RhoI) +/- 1 SE:      0.529  +/-  0.0293
```

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 02-04-2014/14:03:31 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\STANDA~1\FC2_53Z.FTZ
FCT_2,U53Z-26, Kaminiski 4 February 2014

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.708E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.54
SIZE OF COUNTING SQUARE (CM^2): 6.590E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	8.902E+06	(88)	1.082E+07	(107)	15	251.09	36.3	36.6
2	3.794E+06	(30)	6.449E+06	(51)	12	351.05	81.0	81.2
3	9.231E+06	(73)	1.732E+07	(137)	12	387.55	56.5	56.9
4	2.561E+06	(27)	4.268E+06	(45)	16	344.17	83.9	84.2
5	7.081E+06	(70)	1.224E+07	(121)	15	356.95	53.9	54.3
6	5.027E+06	(53)	1.043E+07	(110)	16	428.59	72.0	72.4
7	6.259E+06	(33)	1.195E+07	(63)	8	394.23	84.9	85.2
8	8.536E+06	(45)	1.555E+07	(82)	8	376.29	70.0	70.4
9	7.208E+06	(57)	1.125E+07	(89)	12	322.43	54.9	55.2
10	5.311E+06	(42)	9.737E+06	(77)	12	378.59	72.9	73.2
POOLED	6.238E+06	(518)	1.062E+07	(882)	126	351.61	20.2	21.2
MEAN ZETA (using grain ratios)						352.25	18.7	19.7

CHI-SQUARED PROBABILITY (%): 51.1

MEAN (RhoS/RhoI) +/- 1 SE: 0.586 +/- 0.0298

APPENDIX B:

Fluence Data

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 07-31-2012/11:01:31
U47Z Kaminski 31 July 2012

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	22	0.0	2069	3.200E+05	2.20
	21	4.8	2081	3.217E+05	2.09
	20	9.5	2094	3.234E+05	1.98
	19	14.3	2106	3.251E+05	1.88
	18	19.0	2119	3.269E+05	1.79
	17	23.8	2131	3.286E+05	1.72
	16	28.6	2143	3.303E+05	1.65
	15	33.3	2156	3.320E+05	1.60
	14	38.1	2168	3.337E+05	1.55
	13	42.9	2180	3.354E+05	1.52
	12	47.6	2193	3.371E+05	1.51
	11	52.4	2205	3.389E+05	1.51
	10	57.1	2218	3.406E+05	1.52
	9	61.9	2230	3.423E+05	1.55
	8	66.7	2242	3.440E+05	1.58
	7	71.4	2255	3.457E+05	1.63
	6	76.2	2267	3.474E+05	1.69
	5	81.0	2279	3.491E+05	1.75
	4	85.7	2292	3.509E+05	1.82
	3	90.5	2304	3.526E+05	1.90
	2	95.2	2317	3.543E+05	1.99
SECOND MONITOR:	1	100.0	2329	3.560E+05	2.07

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 07-20-2012/16:05:34
U49Z Fluence Calibration Kaminski/Riehl 19 July 2012

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	1950	3.310E+05	2.26
	2	1.6	1946	3.303E+05	2.23
	3	3.1	1941	3.296E+05	2.20
	4	4.7	1937	3.288E+05	2.17
	5	6.3	1933	3.281E+05	2.15
	6	7.8	1929	3.274E+05	2.12
	7	9.4	1924	3.267E+05	2.09
	8	10.9	1920	3.260E+05	2.06
	9	12.5	1916	3.253E+05	2.03
	10	14.1	1912	3.245E+05	2.01
	11	15.6	1907	3.238E+05	1.98
	12	17.2	1903	3.231E+05	1.96
	13	18.8	1899	3.224E+05	1.93
	14	20.3	1895	3.217E+05	1.91
	15	21.9	1890	3.209E+05	1.89
	16	23.4	1886	3.202E+05	1.86
	17	25.0	1882	3.195E+05	1.84
	18	26.6	1877	3.188E+05	1.82
	19	28.1	1873	3.181E+05	1.80
	20	29.7	1869	3.173E+05	1.78
	21	31.3	1865	3.166E+05	1.77
	22	32.8	1860	3.159E+05	1.75
	23	34.4	1856	3.152E+05	1.74
	24	35.9	1852	3.145E+05	1.72
	25	37.5	1848	3.138E+05	1.71
	26	39.1	1843	3.130E+05	1.70
	27	40.6	1839	3.123E+05	1.69
	28	42.2	1835	3.116E+05	1.68
	29	43.8	1831	3.109E+05	1.67
	30	45.3	1826	3.102E+05	1.67
	31	46.9	1822	3.094E+05	1.66
	32	48.4	1818	3.087E+05	1.66
	33	50.0	1814	3.080E+05	1.66
	34	51.6	1809	3.073E+05	1.66
	35	53.1	1805	3.066E+05	1.66
	36	54.7	1801	3.058E+05	1.67
	37	56.3	1796	3.051E+05	1.67
	38	57.8	1792	3.044E+05	1.68
	39	59.4	1788	3.037E+05	1.69
	40	60.9	1784	3.030E+05	1.70
	41	62.5	1779	3.023E+05	1.71
	42	64.1	1775	3.015E+05	1.73
	43	65.6	1771	3.008E+05	1.74
	44	67.2	1767	3.001E+05	1.76
	45	68.8	1762	2.994E+05	1.78
	46	70.3	1758	2.987E+05	1.80
	47	71.9	1754	2.979E+05	1.82
	48	73.4	1750	2.972E+05	1.85
	49	75.0	1745	2.965E+05	1.87

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 07-20-2012/16:05:34
U49Z Fluence Calibration Kaminski/Riehl 19 July 2012

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
	50	76.6	1741	2.958E+05	1.90
	51	78.1	1737	2.951E+05	1.92
	52	79.7	1732	2.943E+05	1.95
	53	81.3	1728	2.936E+05	1.98
	54	82.8	1724	2.929E+05	2.02
	55	84.4	1720	2.922E+05	2.05
	56	85.9	1715	2.915E+05	2.08
	57	87.5	1711	2.908E+05	2.12
	58	89.1	1707	2.900E+05	2.16
	59	90.6	1703	2.893E+05	2.19
	60	92.2	1698	2.886E+05	2.23
	61	93.8	1694	2.879E+05	2.27
	62	95.3	1690	2.872E+05	2.31
	63	96.9	1686	2.864E+05	2.36
	64	98.4	1681	2.857E+05	2.40
SECOND MONITOR:	65	100.0	1677	2.850E+05	2.44

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 10-12-2012/16:23:21
U50Z 12 October Kaminski

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2558	3.370E+05	1.98
	2	1.9	2547	3.357E+05	1.95
	3	3.7	2536	3.343E+05	1.92
	4	5.6	2525	3.330E+05	1.89
	5	7.4	2514	3.317E+05	1.86
	6	9.3	2503	3.303E+05	1.84
	7	11.1	2492	3.290E+05	1.81
	8	13.0	2481	3.277E+05	1.79
	9	14.8	2470	3.263E+05	1.76
	10	16.7	2459	3.250E+05	1.74
	11	18.5	2447	3.237E+05	1.71
	12	20.4	2436	3.223E+05	1.69
	13	22.2	2425	3.210E+05	1.67
	14	24.1	2414	3.197E+05	1.65
	15	25.9	2403	3.183E+05	1.63
	16	27.8	2392	3.170E+05	1.61
	17	29.6	2381	3.157E+05	1.59
	18	31.5	2370	3.143E+05	1.57
	19	33.3	2359	3.130E+05	1.56
	20	35.2	2348	3.117E+05	1.54
	21	37.0	2337	3.103E+05	1.53
	22	38.9	2326	3.090E+05	1.52
	23	40.7	2315	3.077E+05	1.51
	24	42.6	2304	3.063E+05	1.50
	25	44.4	2293	3.050E+05	1.49
	26	46.3	2282	3.037E+05	1.49
	27	48.1	2271	3.023E+05	1.49
	28	50.0	2260	3.010E+05	1.49
	29	51.9	2248	2.997E+05	1.49
	30	53.7	2237	2.983E+05	1.49
	31	55.6	2226	2.970E+05	1.50
	32	57.4	2215	2.957E+05	1.51
	33	59.3	2204	2.943E+05	1.52
	34	61.1	2193	2.930E+05	1.53
	35	63.0	2182	2.917E+05	1.54
	36	64.8	2171	2.903E+05	1.56
	37	66.7	2160	2.890E+05	1.58
	38	68.5	2149	2.877E+05	1.60
	39	70.4	2138	2.863E+05	1.62
	40	72.2	2127	2.850E+05	1.65
	41	74.1	2116	2.837E+05	1.68
	42	75.9	2105	2.823E+05	1.71
	43	77.8	2094	2.810E+05	1.74
	44	79.6	2083	2.797E+05	1.77
	45	81.5	2072	2.783E+05	1.81
	46	83.3	2061	2.770E+05	1.84
	47	85.2	2049	2.757E+05	1.88
	48	87.0	2038	2.743E+05	1.92
	49	88.9	2027	2.730E+05	1.97

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 10-12-2012/16:23:21
U50Z 12 October Kaminski

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
	50	90.7	2016	2.717E+05	2.01
	51	92.6	2005	2.703E+05	2.06
	52	94.4	1994	2.690E+05	2.11
	53	96.3	1983	2.677E+05	2.15
	54	98.1	1972	2.663E+05	2.21
SECOND MONITOR:	55	100.0	1961	2.650E+05	2.26

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 10-17-2013/11:55:07
U50Z KMK Counted October 2012, October 2013 combined

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	4773	3.380E+05	1.45
	2	1.9	4761	3.368E+05	1.43
	3	3.7	4749	3.355E+05	1.40
	4	5.6	4737	3.343E+05	1.38
	5	7.4	4725	3.330E+05	1.36
	6	9.3	4714	3.318E+05	1.34
	7	11.1	4702	3.306E+05	1.32
	8	13.0	4690	3.293E+05	1.30
	9	14.8	4678	3.281E+05	1.28
	10	16.7	4666	3.268E+05	1.27
	11	18.5	4654	3.256E+05	1.25
	12	20.4	4642	3.244E+05	1.23
	13	22.2	4630	3.231E+05	1.21
	14	24.1	4618	3.219E+05	1.20
	15	25.9	4607	3.206E+05	1.18
	16	27.8	4595	3.194E+05	1.17
	17	29.6	4583	3.181E+05	1.15
	18	31.5	4571	3.169E+05	1.14
	19	33.3	4559	3.157E+05	1.13
	20	35.2	4547	3.144E+05	1.11
	21	37.0	4535	3.132E+05	1.10
	22	38.9	4523	3.119E+05	1.09
	23	40.7	4511	3.107E+05	1.08
	24	42.6	4500	3.095E+05	1.08
	25	44.4	4488	3.082E+05	1.07
	26	46.3	4476	3.070E+05	1.07
	27	48.1	4464	3.057E+05	1.06
	28	50.0	4452	3.045E+05	1.06
	29	51.9	4440	3.033E+05	1.06
	30	53.7	4428	3.020E+05	1.06
	31	55.6	4416	3.008E+05	1.06
	32	57.4	4404	2.995E+05	1.07
	33	59.3	4393	2.983E+05	1.07
	34	61.1	4381	2.971E+05	1.08
	35	63.0	4369	2.958E+05	1.09
	36	64.8	4357	2.946E+05	1.10
	37	66.7	4345	2.933E+05	1.11
	38	68.5	4333	2.921E+05	1.12
	39	70.4	4321	2.909E+05	1.14
	40	72.2	4309	2.896E+05	1.15
	41	74.1	4297	2.884E+05	1.17
	42	75.9	4286	2.871E+05	1.19
	43	77.8	4274	2.859E+05	1.21
	44	79.6	4262	2.846E+05	1.23
	45	81.5	4250	2.834E+05	1.25
	46	83.3	4238	2.822E+05	1.28
	47	85.2	4226	2.809E+05	1.30
	48	87.0	4214	2.797E+05	1.33
	49	88.9	4202	2.784E+05	1.36

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 10-17-2013/11:55:07
U50Z KMK Counted October 2012, October 2013 combined

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
	50	90.7	4190	2.772E+05	1.39
	51	92.6	4179	2.760E+05	1.42
	52	94.4	4167	2.747E+05	1.45
	53	96.3	4155	2.735E+05	1.49
	54	98.1	4143	2.722E+05	1.52
SECOND MONITOR:	55	100.0	4131	2.710E+05	1.56

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================

DATE/TIME: 11-05-2012/17:19:35

U52Z Fluence Kaminski 5 Nov 2012

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2222	3.400E+05	2.12
	2	2.1	2213	3.386E+05	2.09
	3	4.2	2203	3.371E+05	2.05
	4	6.3	2194	3.357E+05	2.02
	5	8.3	2185	3.343E+05	1.98
	6	10.4	2175	3.328E+05	1.95
	7	12.5	2166	3.314E+05	1.92
	8	14.6	2156	3.299E+05	1.89
	9	16.7	2147	3.285E+05	1.86
	10	18.8	2138	3.271E+05	1.83
	11	20.8	2128	3.256E+05	1.80
	12	22.9	2119	3.242E+05	1.77
	13	25.0	2110	3.228E+05	1.75
	14	27.1	2100	3.213E+05	1.72
	15	29.2	2091	3.199E+05	1.70
	16	31.3	2081	3.184E+05	1.68
	17	33.3	2072	3.170E+05	1.66
	18	35.4	2063	3.156E+05	1.64
	19	37.5	2053	3.141E+05	1.63
	20	39.6	2044	3.127E+05	1.61
	21	41.7	2035	3.113E+05	1.60
	22	43.8	2025	3.098E+05	1.59
	23	45.8	2016	3.084E+05	1.59
	24	47.9	2006	3.069E+05	1.58
	25	50.0	1997	3.055E+05	1.58
	26	52.1	1988	3.041E+05	1.58
	27	54.2	1978	3.026E+05	1.59
	28	56.3	1969	3.012E+05	1.59
	29	58.3	1960	2.998E+05	1.60
	30	60.4	1950	2.983E+05	1.62
	31	62.5	1941	2.969E+05	1.63
	32	64.6	1931	2.954E+05	1.65
	33	66.7	1922	2.940E+05	1.67
	34	68.8	1913	2.926E+05	1.70
	35	70.8	1903	2.911E+05	1.73
	36	72.9	1894	2.897E+05	1.76
	37	75.0	1885	2.883E+05	1.79
	38	77.1	1875	2.868E+05	1.82
	39	79.2	1866	2.854E+05	1.86
	40	81.3	1856	2.839E+05	1.90
	41	83.3	1847	2.825E+05	1.95
	42	85.4	1838	2.811E+05	1.99
	43	87.5	1828	2.796E+05	2.04
	44	89.6	1819	2.782E+05	2.09
	45	91.7	1810	2.768E+05	2.14
	46	93.8	1800	2.753E+05	2.20
	47	95.8	1791	2.739E+05	2.26
	48	97.9	1781	2.724E+05	2.31
SECOND MONITOR:	49	100.0	1772	2.710E+05	2.38

=================Fluence Program v. 1.1 (Brandon 7/6/97)=================
DATE/TIME: 01-21-2014/15:43:17
U53Z Fluence Kaminski 21 Jan 2014

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2162	2.750E+05	2.15
	2	1.9	2161	2.748E+05	2.11
	3	3.7	2159	2.747E+05	2.08
	4	5.6	2158	2.745E+05	2.04
	5	7.4	2156	2.743E+05	2.00
	6	9.3	2155	2.742E+05	1.97
	7	11.1	2154	2.740E+05	1.93
	8	13.0	2152	2.738E+05	1.90
	9	14.8	2151	2.737E+05	1.87
	10	16.7	2149	2.735E+05	1.84
	11	18.5	2148	2.733E+05	1.81
	12	20.4	2147	2.732E+05	1.78
	13	22.2	2145	2.730E+05	1.75
	14	24.1	2144	2.728E+05	1.72
	15	25.9	2142	2.727E+05	1.70
	16	27.8	2141	2.725E+05	1.68
	17	29.6	2139	2.723E+05	1.65
	18	31.5	2138	2.722E+05	1.63
	19	33.3	2137	2.720E+05	1.62
	20	35.2	2135	2.718E+05	1.60
	21	37.0	2134	2.717E+05	1.58
	22	38.9	2132	2.715E+05	1.57
	23	40.7	2131	2.713E+05	1.56
	24	42.6	2130	2.712E+05	1.55
	25	44.4	2128	2.710E+05	1.54
	26	46.3	2127	2.708E+05	1.54
	27	48.1	2125	2.707E+05	1.54
	28	50.0	2124	2.705E+05	1.53
	29	51.9	2123	2.703E+05	1.54
	30	53.7	2121	2.702E+05	1.54
	31	55.6	2120	2.700E+05	1.54
	32	57.4	2118	2.698E+05	1.55
	33	59.3	2117	2.697E+05	1.56
	34	61.1	2116	2.695E+05	1.57
	35	63.0	2114	2.693E+05	1.59
	36	64.8	2113	2.692E+05	1.60
	37	66.7	2111	2.690E+05	1.62
	38	68.5	2110	2.688E+05	1.64
	39	70.4	2109	2.687E+05	1.66
	40	72.2	2107	2.685E+05	1.68
	41	74.1	2106	2.683E+05	1.71
	42	75.9	2104	2.682E+05	1.73
	43	77.8	2103	2.680E+05	1.76
	44	79.6	2101	2.678E+05	1.79
	45	81.5	2100	2.677E+05	1.82
	46	83.3	2099	2.675E+05	1.85
	47	85.2	2097	2.673E+05	1.88
	48	87.0	2096	2.672E+05	1.92
	49	88.9	2094	2.670E+05	1.95

```
=================Fluence Program v. 1.1  (Brandon 7/6/97)=================
DATE/TIME: 01-21-2014/15:43:17
U53Z Fluence Kaminski 21 Jan 2014

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========
----------POSITION IN PACKAGE--------   ----EFFECTIVE VALUES AT POSITION----
 Monitor Label  Position  Distance(%)      Nd    RhoD (t/cm^2)  RE[RhoD](%)
                   50         90.7         2093     2.668E+05       1.99
                   51         92.6         2092     2.667E+05       2.03
                   52         94.4         2090     2.665E+05       2.07
                   53         96.3         2089     2.663E+05       2.11
                   54         98.1         2087     2.662E+05       2.15
SECOND MONITOR:    55        100.0         2086     2.660E+05       2.19
```

APPENDIX C:

Grain Age Data

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:29:51 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1302A.FTZ
WB13-02A, U53Z-25 - 11-14 January 2014
Location: Small island at mouth of Still Harbor, directly west of Tikhaia Islands; 20-30 meters from dike
GPS: N 56.55495, W 135.04735
Etch time: 24 hr
Medium- to coarse-grained schist-like sandstone, thick beds with small quartz veins running through, bedding perpendicular to basaltic dikes.

>>NEW PARAMETERS--ZETA METHOD<<

EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):	2.710E+05	
RELATIVE ERROR (%):	1.54	
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):	12.30	
ZETA FACTOR AND STANDARD ERROR (yr cm^2):	344.50	9.20
SIZE OF COUNTER SQUARE (cm^2):	6.590E-07	

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s		Grain Age	Age (Ma) --95% CI--	
1	2.02E+06	(24)	2.36E+06	(28)	18	107	40	39.9	22.1	71.3
2	3.95E+06	(39)	3.34E+06	(33)	15	152	53	54.9	33.7	90.0
3	3.19E+06	(42)	5.16E+06	(68)	20	234	57	28.8	19.1	42.9
4	5.08E+06	(67)	8.95E+06	(118)	20	406	76	26.5	19.3	36.0
5	3.47E+06	(32)	7.80E+06	(72)	14	354	84	20.8	13.2	31.8
6	8.04E+06	(106)	9.33E+06	(123)	20	424	77	40.1	30.8	52.3
7	8.92E+06	(94)	1.13E+07	(119)	16	512	95	36.8	27.9	48.5
8	6.35E+06	(67)	9.10E+06	(96)	16	413	85	32.5	23.4	44.9
9	4.86E+06	(64)	7.66E+06	(101)	20	348	70	29.5	21.2	40.8
10	9.71E+05	(16)	1.03E+06	(17)	25	47	22	43.8	20.7	91.9
11	6.58E+06	(65)	8.90E+06	(88)	15	404	87	34.4	24.6	48.0
12	7.66E+06	(101)	1.03E+07	(136)	20	468	81	34.6	26.6	45.0
13	9.03E+06	(119)	1.13E+07	(149)	20	513	85	37.2	29.1	47.6
14	8.35E+06	(77)	9.43E+06	(87)	14	428	92	41.2	29.9	56.7
15	4.89E+06	(58)	7.17E+06	(85)	18	325	71	31.8	22.3	44.9
16	5.82E+06	(69)	8.85E+06	(105)	18	402	79	30.6	22.2	41.9
17	9.77E+06	(103)	1.09E+07	(115)	16	495	93	41.7	31.8	54.7
18	6.65E+06	(92)	9.39E+06	(130)	21	426	76	33.0	25.1	43.3
19	7.28E+06	(96)	1.04E+07	(137)	20	472	82	32.7	25.0	42.7
20	3.41E+06	(36)	5.12E+06	(54)	16	232	63	31.1	19.8	48.2
21	6.83E+06	(72)	8.44E+06	(89)	16	383	82	37.7	27.2	52.0
22	4.12E+06	(57)	5.93E+06	(82)	21	269	60	32.4	22.7	46.0
23	7.08E+06	(70)	9.81E+06	(97)	15	445	91	33.6	24.3	46.2
24	1.35E+07	(71)	1.31E+07	(69)	8	594	144	47.9	33.9	67.7
25	8.35E+06	(33)	1.11E+07	(44)	6	505	152	35.0	21.5	56.1
26	2.60E+06	(36)	3.03E+06	(42)	21	138	42	39.9	24.8	63.7
27	2.87E+06	(34)	3.79E+06	(45)	18	172	51	35.2	21.9	56.1
28	3.12E+06	(37)	4.72E+06	(56)	18	214	57	30.8	19.7	47.4
29	6.07E+06	(56)	7.80E+06	(72)	14	354	84	36.2	25.1	52.1
30	6.07E+06	(64)	8.82E+06	(93)	16	400	84	32.1	22.9	44.6

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:29:51 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1302A.FTZ
WB13-02A, U53Z-25 - 11-14 January 2014
Number of grains =  30
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)          Age   --95% CI--  (%)    Age   --95% CI--
  5  3.47E+06 (  32) 7.80E+06 (  72)  20.8  13.2  31.8 100.0   20.8  13.2  31.8
  4  5.08E+06 (  67) 8.95E+06 ( 118)  26.5  19.3  36.0  34.9   24.3  19.0  31.2
  3  3.19E+06 (  42) 5.16E+06 (  68)  28.8  19.1  42.9  49.6   25.5  20.6  31.6
  9  4.86E+06 (  64) 7.66E+06 ( 101)  29.5  21.2  40.8  57.6   26.6  22.2  31.9
 16  5.82E+06 (  69) 8.85E+06 ( 105)  30.6  22.2  41.9  62.9   27.5  23.4  32.3
 28  3.12E+06 (  37) 4.72E+06 (  56)  30.8  19.7  47.4  72.6   27.9  23.9  32.5
 20  3.41E+06 (  36) 5.12E+06 (  54)  31.1  19.8  48.2  80.2   28.2  24.3  32.6
 15  4.89E+06 (  58) 7.17E+06 (  85)  31.8  22.3  44.9  83.8   28.6  25.0  32.9
 30  6.07E+06 (  64) 8.82E+06 (  93)  32.1  22.9  44.6  86.7   29.1  25.5  33.1
 22  4.12E+06 (  57) 5.93E+06 (  82)  32.4  22.7  46.0  89.6   29.4  25.9  33.3
  8  6.35E+06 (  67) 9.10E+06 (  96)  32.5  23.4  44.9  91.7   29.7  26.4  33.5
 19  7.28E+06 (  96) 1.04E+07 ( 137)  32.7  25.0  42.7  93.1   30.1  26.9  33.7
 18  6.65E+06 (  92) 9.39E+06 ( 130)  33.0  25.1  43.3  94.3   30.4  27.3  33.9
 23  7.08E+06 (  70) 9.81E+06 (  97)  33.6  24.3  46.2  95.4   30.6  27.6  34.0
 11  6.58E+06 (  65) 8.90E+06 (  88)  34.4  24.6  48.0  96.0   30.9  27.9  34.2
 12  7.66E+06 ( 101) 1.03E+07 ( 136)  34.6  26.6  45.0  96.1   31.2  28.2  34.5
 25  8.35E+06 (  33) 1.11E+07 (  44)  35.0  21.5  56.1  97.1   31.3  28.4  34.6
 27  2.87E+06 (  34) 3.79E+06 (  45)  35.2  21.9  56.1  97.8   31.4  28.5  34.6
 29  6.07E+06 (  56) 7.80E+06 (  72)  36.2  25.1  52.1  97.9   31.6  28.7  34.8
  7  8.92E+06 (  94) 1.13E+07 ( 119)  36.8  27.9  48.5  97.2   32.0  29.1  35.1
 13  9.03E+06 ( 119) 1.13E+07 ( 149)  37.2  29.1  47.6  95.9   32.4  29.5  35.5
 21  6.83E+06 (  72) 8.44E+06 (  89)  37.7  27.2  52.0  95.6   32.6  29.8  35.7
 26  2.60E+06 (  36) 3.03E+06 (  42)  39.9  24.8  63.7  95.6   32.7  29.9  35.8
  1  2.02E+06 (  24) 2.36E+06 (  28)  39.9  22.1  71.3  96.0   32.8  30.0  35.9
  6  8.04E+06 ( 106) 9.33E+06 ( 123)  40.1  30.8  52.3  92.9   33.2  30.4  36.3
 14  8.35E+06 (  77) 9.43E+06 (  87)  41.2  29.9  56.7  89.9   33.5  30.7  36.6
 17  9.77E+06 ( 103) 1.09E+07 ( 115)  41.7  31.8  54.7  83.9   33.9  31.1  37.0
 10  9.71E+05 (  16) 1.03E+06 (  17)  43.8  20.7  91.9  85.2   34.0  31.2  37.0
 24  1.35E+07 (  71) 1.31E+07 (  69)  47.9  33.9  67.7  71.0   34.4  31.6  37.4
  2  3.95E+06 (  39) 3.34E+06 (  33)  54.9  33.7  90.0  55.1   34.6  31.8  37.7
POOL 5.59E+06( 1897) 7.51E+06( 2550)                     55.1   34.6  31.8  37.7

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  341.0,  17.1

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   34.6,  33.2 --  36.2 (  -1.5   +1.5)
                 95% CONF. INTERVAL(Ma):         31.8 --  37.7 (  -2.8   +3.1)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.9446,   29
                      CHI^2 PROBABILITY:   55.1%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   34.6,  33.2 --  36.2 (  -1.5   +1.5)
                 95% CONF. INTERVAL(Ma):         31.8 --  37.7 (  -2.8   +3.1)
                     AGE DISPERSION (%):    1.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   34.6,  33.2 --  36.2 (  -1.5   +1.5)
                95% CONF. INTERVAL (Ma):         31.8 --  37.7 (  -2.8   +3.1)
        NUMBER AND PERCENTAGE OF GRAINS:   30,   100%
```

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:30:05 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1303A.FTZ
WB13-03A, U53Z-23 - 16-21 January 2014
Location: Small island at mouth of Still Harbor, directly west of Tikhaia Islands; directly next to dike
GPS: N 56.55495, W 135.04735
Etch time: 22 hr
Coarse-grained metamorphosed sandstone in direct contact with dike.

>>NEW PARAMETERS--ZETA METHOD<<

EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):	2.713E+05	
RELATIVE ERROR (%):	1.56	
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):	12.30	
ZETA FACTOR AND STANDARD ERROR (yr cm^2):	344.50	9.20
SIZE OF COUNTER SQUARE (cm^2):	6.590E-07	

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U	+/-2s	Grain Age	Age (Ma) --95% CI--	
1	9.64E+06	(127)	1.14E+07	(150)	20	516	86	39.5	31.0	50.3
2	2.73E+06	(27)	2.93E+06	(29)	15	133	49	43.4	24.7	75.8
3	6.88E+06	(68)	1.05E+07	(104)	15	477	95	30.5	22.1	41.8
4	3.32E+06	(46)	5.93E+06	(82)	21	269	60	26.2	17.8	38.0
5	6.07E+06	(84)	9.39E+06	(130)	21	426	76	30.2	22.8	39.9
6	8.06E+06	(85)	9.86E+06	(104)	16	447	89	38.1	28.5	51.0
7	5.92E+06	(78)	1.01E+07	(133)	20	458	80	27.4	20.6	36.4
8	7.33E+06	(58)	1.20E+07	(95)	12	545	113	28.5	20.2	39.9
9	6.83E+06	(54)	7.46E+06	(59)	12	338	88	42.6	28.9	62.7
10	5.48E+06	(65)	7.50E+06	(89)	18	340	73	34.1	24.3	47.4
11	1.00E+07	(119)	1.50E+07	(178)	18	680	104	31.2	24.6	39.6
12	7.71E+06	(61)	9.74E+06	(77)	12	441	101	36.9	25.9	52.4
13	4.38E+06	(52)	5.99E+06	(71)	18	271	65	34.2	23.4	49.5
14	7.59E+06	(60)	9.61E+06	(76)	12	436	101	36.8	25.8	52.3
15	4.70E+06	(62)	6.98E+06	(92)	20	316	67	31.4	22.4	43.9
16	6.70E+06	(53)	9.99E+06	(79)	12	453	103	31.3	21.6	44.9
17	4.72E+06	(56)	8.77E+06	(104)	18	397	79	25.2	17.8	35.1
18	8.01E+06	(95)	1.16E+07	(138)	18	527	91	32.1	24.6	42.0
19	2.96E+06	(41)	3.69E+06	(51)	21	167	47	37.5	24.2	57.6
20	1.37E+07	(108)	1.83E+07	(145)	12	831	140	34.8	26.9	44.9
21	5.01E+06	(66)	8.73E+06	(115)	20	396	75	26.8	19.4	36.6
22	8.19E+06	(108)	1.20E+07	(158)	20	543	88	31.9	24.8	41.0
23	6.72E+06	(93)	1.03E+07	(142)	21	465	79	30.6	23.4	40.0
24	4.55E+06	(42)	7.91E+06	(73)	14	359	84	26.9	17.9	39.8
25	4.93E+06	(65)	5.99E+06	(79)	20	272	62	38.4	27.2	53.9
26	6.47E+06	(64)	7.89E+06	(78)	15	358	82	38.3	27.0	53.9
27	7.95E+06	(110)	1.11E+07	(154)	21	505	83	33.3	25.9	42.8
28	6.15E+06	(73)	6.91E+06	(82)	18	313	70	41.5	29.8	57.6
29	4.34E+06	(60)	7.80E+06	(108)	21	354	69	25.9	18.6	35.9
30	8.82E+06	(93)	1.05E+07	(111)	16	477	92	39.1	29.5	51.7

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:30:05 FILENAME:

C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1303A.FTZ

WB13-03A, U53Z-23 - 16-21 January 2014

Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95%	CI--	P(X2) (%)	Sum age (Ma) Age	--95%	CI--
17	4.72E+06	(56)	8.77E+06	(104)	25.2	17.8	35.1	100.0	25.2	17.8	35.1
29	4.34E+06	(60)	7.80E+06	(108)	25.9	18.6	35.9	89.2	25.6	20.2	32.3
4	3.32E+06	(46)	5.93E+06	(82)	26.2	17.8	38.0	98.4	25.7	21.1	31.4
21	5.01E+06	(66)	8.73E+06	(115)	26.8	19.4	36.6	99.4	26.0	21.9	30.9
24	4.55E+06	(42)	7.91E+06	(73)	26.9	17.9	39.8	99.9	26.1	22.3	30.7
7	5.92E+06	(78)	1.01E+07	(133)	27.4	20.6	36.4	99.9	26.4	22.9	30.5
8	7.33E+06	(58)	1.20E+07	(95)	28.5	20.2	39.9	99.9	26.7	23.3	30.6
5	6.07E+06	(84)	9.39E+06	(130)	30.2	22.8	39.9	99.5	27.2	24.0	30.9
3	6.88E+06	(68)	1.05E+07	(104)	30.5	22.1	41.8	99.3	27.6	24.4	31.1
23	6.72E+06	(93)	1.03E+07	(142)	30.6	23.4	40.0	99.2	28.0	24.9	31.3
11	1.00E+07	(119)	1.50E+07	(178)	31.2	24.6	39.6	98.8	28.4	25.5	31.6
16	6.70E+06	(53)	9.99E+06	(79)	31.3	21.6	44.9	99.1	28.6	25.7	31.8
15	4.70E+06	(62)	6.98E+06	(92)	31.4	22.4	43.9	99.3	28.8	25.9	31.9
22	8.19E+06	(108)	1.20E+07	(158)	31.9	24.8	41.0	99.3	29.1	26.3	32.1
18	8.01E+06	(95)	1.16E+07	(138)	32.1	24.6	42.0	99.3	29.3	26.6	32.3
27	7.95E+06	(110)	1.11E+07	(154)	33.3	25.9	42.8	98.9	29.6	27.0	32.6
10	5.48E+06	(65)	7.50E+06	(89)	34.1	24.3	47.4	98.8	29.8	27.2	32.7
13	4.38E+06	(52)	5.99E+06	(71)	34.2	23.4	49.5	98.9	30.0	27.4	32.9
20	1.37E+07	(108)	1.83E+07	(145)	34.8	26.9	44.9	98.2	30.3	27.7	33.1
14	7.59E+06	(60)	9.61E+06	(76)	36.8	25.8	52.3	97.4	30.5	27.9	33.4
12	7.71E+06	(61)	9.74E+06	(77)	36.9	25.9	52.4	96.5	30.7	28.1	33.6
19	2.96E+06	(41)	3.69E+06	(51)	37.5	24.2	57.6	96.2	30.9	28.3	33.7
6	8.06E+06	(85)	9.86E+06	(104)	38.1	28.5	51.0	93.4	31.2	28.6	34.0
26	6.47E+06	(64)	7.89E+06	(78)	38.3	27.0	53.9	91.5	31.4	28.8	34.2
25	4.93E+06	(65)	5.99E+06	(79)	38.4	27.2	53.9	89.6	31.6	29.0	34.4
30	8.82E+06	(93)	1.05E+07	(111)	39.1	29.5	51.7	84.5	31.9	29.3	34.7
1	9.64E+06	(127)	1.14E+07	(150)	39.5	31.0	50.3	75.0	32.3	29.7	35.1
28	6.15E+06	(73)	6.91E+06	(82)	41.5	29.8	57.6	67.5	32.5	30.0	35.3
9	6.83E+06	(54)	7.46E+06	(59)	42.6	28.9	62.7	61.7	32.7	30.2	35.5
2	2.73E+06	(27)	2.93E+06	(29)	43.4	24.7	75.8	60.9	32.8	30.3	35.6
POOL	6.38E+06	(2173)	9.06E+06	(3086)				60.9	32.8	30.3	35.6

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 410.7, 19.6

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 32.8, 31.5 -- 34.2 (-1.3 +1.4)
95% CONF. INTERVAL(Ma): 30.3 -- 35.6 (-2.6 +2.8)
REDUCED CHI^2, DEGREES OF FREEDOM: 0.9070, 29
CHI^2 PROBABILITY: 60.9%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 32.8, 31.5 -- 34.2 (-1.3 +1.4)
95% CONF. INTERVAL(Ma): 30.2 -- 35.6 (-2.6 +2.8)
AGE DISPERSION (%): 1.0

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 32.8, 31.5 -- 34.2 (-1.3 +1.4)
95% CONF. INTERVAL (Ma): 30.3 -- 35.6 (-2.6 +2.8)
NUMBER AND PERCENTAGE OF GRAINS: 30, 100%

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===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:30:16 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1304B.FTZ
WB13-04b, U53Z-20 - 1-4 February 2014
Location: Entrance to Great Arm, Whale Bay
GPS: N 56.62262, W 134.93942
Etch time: 21.75 hr
Thickly-bedded, medium- to coarse-grained sandstone with muscovite.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.718E+05
                                        RELATIVE ERROR (%):      1.60
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    344.50     9.20
                           SIZE OF COUNTER SQUARE (cm^2):      6.590E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
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Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U	+/-2s	Grain Age	Age (Ma) --95% CI--	
1	1.38E+07	(127)	1.67E+07	(154)	14	755	124	38.5	30.3	49.0
2	1.18E+07	(155)	1.18E+07	(156)	20	536	87	46.4	36.8	58.3
3	7.51E+06	(104)	1.28E+07	(177)	21	579	89	27.5	21.4	35.3
4	7.44E+06	(98)	1.00E+07	(132)	20	453	80	34.7	26.6	45.3
5	3.41E+06	(45)	4.86E+06	(64)	20	220	55	32.9	21.9	48.8
6	8.94E+06	(106)	1.10E+07	(130)	18	496	88	38.1	29.3	49.5
7	6.70E+06	(53)	1.01E+07	(80)	12	458	103	31.0	21.4	44.4
8	9.61E+06	(76)	1.20E+07	(95)	12	544	113	37.4	27.2	51.1
9	8.65E+06	(114)	1.09E+07	(144)	20	494	84	37.0	28.7	47.6
10	8.22E+06	(65)	8.35E+06	(66)	12	378	93	45.9	32.1	65.7
11	8.50E+06	(112)	1.32E+07	(174)	20	597	92	30.1	23.6	38.4
12	1.33E+07	(140)	1.43E+07	(151)	16	648	107	43.3	34.1	54.8
13	6.45E+06	(85)	8.95E+06	(118)	20	405	76	33.7	25.4	44.8
14	8.35E+06	(110)	1.14E+07	(150)	20	515	86	34.3	26.6	44.1
15	1.04E+07	(82)	1.58E+07	(125)	12	715	130	30.7	23.1	40.8
16	8.06E+06	(85)	1.01E+07	(106)	16	455	89	37.5	28.0	50.1
17	3.34E+06	(44)	4.78E+06	(63)	20	216	55	32.7	21.7	48.7
18	1.52E+07	(120)	1.64E+07	(130)	12	744	132	43.1	33.4	55.5
19	8.92E+06	(94)	8.06E+06	(85)	16	365	80	51.6	38.0	70.0
20	9.48E+06	(125)	1.14E+07	(150)	20	515	86	38.9	30.5	49.7
21	5.77E+06	(76)	6.22E+06	(82)	20	282	63	43.3	31.2	59.8
22	1.21E+07	(144)	1.72E+07	(204)	18	778	112	33.0	26.5	41.2
23	3.57E+06	(47)	4.78E+06	(63)	20	216	55	34.9	23.3	51.6
24	4.43E+06	(35)	6.83E+06	(54)	12	309	84	30.3	19.2	47.2
25	1.26E+07	(75)	1.33E+07	(79)	9	603	137	44.3	31.8	61.6
26	4.65E+06	(46)	4.55E+06	(45)	15	206	61	47.7	30.9	73.5
27	8.70E+06	(86)	1.16E+07	(115)	15	526	99	35.0	26.3	46.5
28	3.79E+06	(30)	4.93E+06	(39)	12	223	71	36.0	21.5	59.3
29	6.54E+06	(69)	9.67E+06	(102)	16	438	88	31.6	22.9	43.3
30	5.16E+06	(51)	6.68E+06	(66)	15	302	75	36.1	24.5	52.8

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:30:16 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1304B.FTZ
WB13-04b, U53Z-20 - 1-4 February 2014
Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
3	7.51E+06	(104)	1.28E+07	(177)	27.5	21.4	35.3	100.0	27.5	21.4	35.3
11	8.50E+06	(112)	1.32E+07	(174)	30.1	23.6	38.4	59.8	28.8	24.0	34.4
24	4.43E+06	(35)	6.83E+06	(54)	30.3	19.2	47.2	84.9	29.0	24.5	34.3
15	1.04E+07	(82)	1.58E+07	(125)	30.7	23.1	40.8	93.0	29.4	25.3	34.1
7	6.70E+06	(53)	1.01E+07	(80)	31.0	21.4	44.4	97.1	29.6	25.7	34.0
29	6.54E+06	(69)	9.67E+06	(102)	31.6	22.9	43.3	98.4	29.9	26.2	34.1
17	3.34E+06	(44)	4.78E+06	(63)	32.7	21.7	48.7	99.0	30.1	26.5	34.2
5	3.41E+06	(45)	4.86E+06	(64)	32.9	21.9	48.8	99.4	30.3	26.8	34.3
22	1.21E+07	(144)	1.72E+07	(204)	33.0	26.5	41.2	99.2	30.8	27.5	34.5
13	6.45E+06	(85)	8.95E+06	(118)	33.7	25.4	44.8	99.3	31.1	27.9	34.7
14	8.35E+06	(110)	1.14E+07	(150)	34.3	26.6	44.1	99.2	31.5	28.3	34.9
4	7.44E+06	(98)	1.00E+07	(132)	34.7	26.6	45.3	99.2	31.8	28.7	35.1
23	3.57E+06	(47)	4.78E+06	(63)	34.9	23.3	51.6	99.5	31.9	28.9	35.2
27	8.70E+06	(86)	1.16E+07	(115)	35.0	26.3	46.5	99.6	32.1	29.1	35.4
28	3.79E+06	(30)	4.93E+06	(39)	36.0	21.5	59.3	99.7	32.2	29.2	35.5
30	5.16E+06	(51)	6.68E+06	(66)	36.1	24.5	52.8	99.8	32.3	29.4	35.6
9	8.65E+06	(114)	1.09E+07	(144)	37.0	28.7	47.6	99.5	32.7	29.8	35.9
8	9.61E+06	(76)	1.20E+07	(95)	37.4	27.2	51.1	99.5	32.9	30.0	36.1
16	8.06E+06	(85)	1.01E+07	(106)	37.5	28.0	50.1	99.4	33.1	30.3	36.3
6	8.94E+06	(106)	1.10E+07	(130)	38.1	29.3	49.5	99.1	33.4	30.6	36.5
1	1.38E+07	(127)	1.67E+07	(154)	38.5	30.3	49.0	98.5	33.8	31.0	36.8
20	9.48E+06	(125)	1.14E+07	(150)	38.9	30.5	49.7	97.7	34.1	31.3	37.1
18	1.52E+07	(120)	1.64E+07	(130)	43.1	33.4	55.5	92.3	34.5	31.7	37.6
21	5.77E+06	(76)	6.22E+06	(82)	43.3	31.2	59.8	88.4	34.8	32.0	37.8
12	1.33E+07	(140)	1.43E+07	(151)	43.3	34.1	54.8	77.5	35.2	32.4	38.3
25	1.26E+07	(75)	1.33E+07	(79)	44.3	31.8	61.6	71.9	35.5	32.7	38.5
10	8.22E+06	(65)	8.35E+06	(66)	45.9	32.1	65.7	65.2	35.7	32.9	38.7
2	1.18E+07	(155)	1.18E+07	(156)	46.4	36.8	58.3	42.8	36.2	33.4	39.3
26	4.65E+06	(46)	4.55E+06	(45)	47.7	30.9	73.5	39.4	36.4	33.6	39.4
19	8.92E+06	(94)	8.06E+06	(85)	51.6	38.0	70.0	21.5	36.8	34.0	39.8
POOL	8.00E+06	(2599)	1.02E+07	(3299)				21.5	36.8	34.0	39.8

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 459.5, 21.7

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 36.8, 35.3 -- 38.3 (-1.5 +1.5)
95% CONF. INTERVAL(Ma): 34.0 -- 39.8 (-2.8 +3.0)
REDUCED CHI^2, DEGREES OF FREEDOM: 1.1957, 29
CHI^2 PROBABILITY: 21.5%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 36.8, 35.2 -- 38.4 (-1.5 +1.6)
95% CONF. INTERVAL(Ma): 33.8 -- 40.0 (-3.0 +3.2)
AGE DISPERSION (%): 7.3

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 36.8, 35.3 -- 38.3 (-1.5 +1.5)
95% CONF. INTERVAL (Ma): 34.0 -- 39.8 (-2.8 +3.0)
NUMBER AND PERCENTAGE OF GRAINS: 30, 100%

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:30:27 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1306A.FTZ
WB13-06a, U53Z-19 - 23-28 January 2014
Location: Crawfish Inlet pluton unit of Great Arm
GPS: N 56.722338, W 134.84680
Etch time: 18.25 hr
Granite containing biotite, quartz, and feldspar.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.720E+05
RELATIVE ERROR (%): 1.62
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s		Grain Age	--95% CI--	
1	1.10E+07	(130)	1.29E+07	(153)	18	583	96	39.7	31.2	50.5
2	1.35E+07	(107)	1.34E+07	(106)	12	606	119	47.1	35.8	62.0
3	1.15E+07	(106)	1.38E+07	(127)	14	622	112	39.0	30.0	50.8
4	1.04E+07	(123)	8.43E+06	(100)	18	381	77	57.3	43.8	75.0
5	3.98E+06	(42)	6.92E+06	(73)	16	313	74	26.9	17.9	39.9
6	4.02E+06	(53)	6.07E+06	(80)	20	274	62	31.0	21.4	44.4
7	8.40E+06	(83)	9.81E+06	(97)	15	444	91	40.0	29.4	54.2
8	1.12E+07	(155)	1.33E+07	(184)	21	601	91	39.4	31.5	49.1
9	1.10E+07	(130)	1.23E+07	(146)	18	557	94	41.6	32.6	53.0
10	6.91E+06	(82)	8.60E+06	(102)	18	389	78	37.6	27.7	50.8
11	6.91E+06	(41)	1.64E+07	(97)	9	740	152	19.8	13.4	28.8
12	9.33E+06	(123)	1.03E+07	(136)	20	467	81	42.3	32.9	54.3
13	1.10E+07	(152)	1.26E+07	(175)	21	572	88	40.6	32.4	50.8
14	4.72E+06	(56)	7.76E+06	(92)	18	351	74	28.5	20.0	40.1
15	5.24E+06	(69)	8.57E+06	(113)	20	388	74	28.6	20.8	38.9
16	1.13E+07	(104)	1.30E+07	(120)	14	588	109	40.5	31.0	53.0
17	7.00E+06	(83)	1.22E+07	(145)	18	553	93	26.8	20.4	35.3
18	4.81E+06	(57)	5.99E+06	(71)	18	271	65	37.5	26.0	53.9
19	5.31E+06	(70)	8.57E+06	(113)	20	388	74	29.0	21.2	39.4
20	7.15E+06	(99)	8.53E+06	(118)	21	386	72	39.2	29.9	51.5
21	4.66E+06	(83)	6.91E+06	(123)	27	313	57	31.6	23.8	42.0
22	7.89E+06	(78)	1.34E+07	(132)	15	604	107	27.7	20.8	36.8
23	4.84E+06	(51)	7.59E+06	(80)	16	343	77	29.8	20.5	42.9
24	6.64E+06	(70)	7.97E+06	(84)	16	360	79	38.9	27.9	54.1
25	3.41E+06	(27)	7.21E+06	(57)	12	326	87	22.2	13.5	35.6
26	6.07E+06	(56)	8.56E+06	(79)	14	387	88	33.2	23.1	47.3
27	9.03E+06	(125)	1.56E+07	(216)	21	706	99	27.1	21.6	34.0
28	2.10E+07	(83)	1.59E+07	(63)	6	721	182	61.4	43.7	86.6
29	7.13E+06	(94)	8.04E+06	(106)	20	364	71	41.4	31.2	55.0
30	6.07E+06	(72)	9.61E+06	(114)	18	435	82	29.5	21.6	40.0

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:30:27 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1306A.FTZ
WB13-06a, U53Z-19 - 23-28 January 2014
Number of grains = 30
------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
11	6.91E+06	(41)	1.64E+07	(97)	19.8	13.4	28.8	100.0	19.8	13.4	28.8
25	3.41E+06	(27)	7.21E+06	(57)	22.2	13.5	35.6	70.3	20.7	15.5	27.7
17	7.00E+06	(83)	1.22E+07	(145)	26.8	20.4	35.3	40.3	23.7	19.3	29.0
5	3.98E+06	(42)	6.92E+06	(73)	26.9	17.9	39.9	53.9	24.3	20.2	29.2
27	9.03E+06	(125)	1.56E+07	(216)	27.1	21.6	34.0	60.6	25.3	21.8	29.4
22	7.89E+06	(78)	1.34E+07	(132)	27.7	20.8	36.8	69.8	25.7	22.4	29.5
14	4.72E+06	(56)	7.76E+06	(92)	28.5	20.0	40.1	76.8	26.0	22.9	29.7
15	5.24E+06	(69)	8.57E+06	(113)	28.6	20.8	38.9	82.1	26.3	23.3	29.8
19	5.31E+06	(70)	8.57E+06	(113)	29.0	21.2	39.4	86.0	26.6	23.7	30.0
30	6.07E+06	(72)	9.61E+06	(114)	29.5	21.6	40.0	88.5	26.9	24.0	30.1
23	4.84E+06	(51)	7.59E+06	(80)	29.8	20.5	42.9	91.2	27.1	24.3	30.3
6	4.02E+06	(53)	6.07E+06	(80)	31.0	21.4	44.4	92.1	27.3	24.5	30.5
21	4.66E+06	(83)	6.91E+06	(123)	31.6	23.8	42.0	91.1	27.7	25.0	30.7
26	6.07E+06	(56)	8.56E+06	(79)	33.2	23.1	47.3	89.8	28.0	25.3	31.0
18	4.81E+06	(57)	5.99E+06	(71)	37.5	26.0	53.9	78.6	28.4	25.7	31.4
10	6.91E+06	(82)	8.60E+06	(102)	37.6	27.7	50.8	60.6	29.0	26.3	32.0
24	6.64E+06	(70)	7.97E+06	(84)	38.9	27.9	54.1	44.7	29.4	26.7	32.4
3	1.15E+07	(106)	1.38E+07	(127)	39.0	30.0	50.8	26.1	30.1	27.4	33.0
20	7.15E+06	(99)	8.53E+06	(118)	39.2	29.9	51.5	16.3	30.6	27.9	33.6
8	1.12E+07	(155)	1.33E+07	(184)	39.4	31.5	49.1	7.4	31.3	28.6	34.3
1	1.10E+07	(130)	1.29E+07	(153)	39.7	31.2	50.5	4.3	31.9	29.2	34.8
7	8.40E+06	(83)	9.81E+06	(97)	40.0	29.4	54.2	3.4	32.2	29.5	35.1
16	1.13E+07	(104)	1.30E+07	(120)	40.5	31.0	53.0	2.4	32.6	29.9	35.5
13	1.10E+07	(152)	1.26E+07	(175)	40.6	32.4	50.8	1.4	33.1	30.4	36.0
29	7.13E+06	(94)	8.04E+06	(106)	41.4	31.2	55.0	1.0	33.4	30.7	36.3
9	1.10E+07	(130)	1.23E+07	(146)	41.6	32.6	53.0	0.7	33.8	31.1	36.7
12	9.33E+06	(123)	1.03E+07	(136)	42.3	32.9	54.3	0.4	34.2	31.5	37.1
2	1.35E+07	(107)	1.34E+07	(106)	47.1	35.8	62.0	0.1	34.6	31.9	37.5
4	1.04E+07	(123)	8.43E+06	(100)	57.3	43.8	75.0	0.0	35.3	32.6	38.2
28	2.10E+07	(83)	1.59E+07	(63)	61.4	43.7	86.6	0.0	35.8	33.0	38.7
POOL	7.69E+06	(2604)	1.00E+07	(3402)				0.0	35.8	33.0	38.7

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 454.2, 21.4

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 35.8, 34.3 -- 37.2 (-1.4 +1.5)
95% CONF. INTERVAL(Ma): 33.0 -- 38.7 (-2.7 +3.0)
REDUCED CHI^2, DEGREES OF FREEDOM: 2.7210, 29
CHI^2 PROBABILITY: 0.0%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 35.3, 33.5 -- 37.2 (-1.8 +1.9)
95% CONF. INTERVAL(Ma): 31.8 -- 39.2 (-3.5 +3.9)
AGE DISPERSION (%): 18.5

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 33.4, 32.0 -- 34.9 (-1.4 +1.5)
95% CONF. INTERVAL (Ma): 30.7 -- 36.3 (-2.7 +2.9)
NUMBER AND PERCENTAGE OF GRAINS: 25, 83%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================

DATE/TIME: 02-04-2014/15:30:43 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1309A.FTZ
WB13-09a, U53Z-17 - 21 Nov 2013, 14 January 2014
Location: Port Banks, Whale Bay
GPS: N 56.59026, W 135.01627
Etch time: 24 hr
Coarse-grained graywacke-sandstone interbedded with black shale.

>>NEW PARAMETERS--ZETA METHOD<<

EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.723E+05
RELATIVE ERROR (%): 1.65
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U	+/-2s	Grain Age	--95% CI--	
1	8.09E+06	(64)	1.13E+07	(89)	12	508	109	33.7	24.0	46.9
2	6.26E+06	(66)	7.40E+06	(78)	16	334	76	39.6	28.0	55.7
3	1.55E+07	(92)	1.57E+07	(93)	9	708	148	46.2	34.5	62.0
4	5.36E+06	(53)	7.99E+06	(79)	15	361	82	31.4	21.7	45.1
5	6.92E+06	(73)	9.48E+06	(100)	16	428	87	34.2	24.9	46.7
6	1.00E+07	(99)	1.09E+07	(108)	15	494	96	42.9	32.5	56.6
7	7.15E+06	(66)	8.78E+06	(81)	14	397	89	38.1	27.1	53.4
8	5.92E+06	(39)	7.28E+06	(48)	10	329	95	38.0	24.2	59.2
9	1.82E+07	(108)	1.77E+07	(105)	9	800	158	48.1	36.5	63.2
10	6.07E+06	(60)	8.09E+06	(80)	15	366	82	35.1	24.7	49.7
11	7.02E+06	(37)	1.65E+07	(87)	8	745	161	20.0	13.2	29.6
12	1.05E+07	(69)	1.46E+07	(96)	10	658	136	33.7	24.3	46.3
13	7.18E+06	(71)	9.00E+06	(89)	15	407	87	37.3	26.9	51.6
14	1.01E+07	(107)	1.26E+07	(133)	16	570	100	37.7	29.0	48.9
15	4.36E+06	(46)	8.25E+06	(87)	16	373	81	24.8	16.9	35.8
16	8.47E+06	(67)	1.24E+07	(98)	12	560	114	32.0	23.1	44.1
17	8.30E+06	(82)	7.28E+06	(72)	15	329	78	53.2	38.3	74.1
18	1.21E+07	(72)	1.50E+07	(89)	9	678	145	37.9	27.3	52.2
19	6.07E+06	(48)	7.21E+06	(57)	12	326	87	39.4	26.2	58.8
20	9.10E+06	(84)	9.54E+06	(88)	14	431	93	44.6	32.7	60.9
21	4.17E+06	(55)	6.22E+06	(82)	20	281	63	31.4	21.9	44.7
22	3.64E+06	(48)	5.46E+06	(72)	20	247	59	31.2	21.2	45.6
23	6.15E+06	(81)	7.51E+06	(99)	20	339	69	38.3	28.1	51.9
24	4.72E+06	(28)	8.09E+06	(48)	9	366	106	27.4	16.5	44.4
25	3.71E+06	(44)	3.54E+06	(42)	18	160	49	48.9	31.3	76.5
26	1.18E+07	(124)	1.50E+07	(158)	16	677	110	36.7	28.8	46.8
27	5.69E+06	(75)	7.51E+06	(99)	20	339	69	35.5	25.9	48.4
28	5.67E+06	(56)	6.47E+06	(64)	15	292	73	40.9	28.0	59.5
29	5.36E+06	(53)	7.59E+06	(75)	15	343	80	33.1	22.8	47.7
30	8.98E+06	(71)	1.04E+07	(82)	12	468	104	40.5	29.0	56.4

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:30:43 FILENAME:

C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1309A.FTZ

WB13-09a, U53Z-17 - 21 Nov 2013, 14 January 2014

Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
11	7.02E+06	(37)	1.65E+07	(87)	20.0	13.2	29.6	100.0	20.0	13.2	29.6
15	4.36E+06	(46)	8.25E+06	(87)	24.8	16.9	35.8	41.6	22.4	17.1	29.3
24	4.72E+06	(28)	8.09E+06	(48)	27.4	16.5	44.4	55.0	23.5	18.5	29.7
22	3.64E+06	(48)	5.46E+06	(72)	31.2	21.2	45.6	40.9	25.4	20.7	31.0
21	4.17E+06	(55)	6.22E+06	(82)	31.4	21.9	44.7	40.5	26.7	22.3	31.9
4	5.36E+06	(53)	7.99E+06	(79)	31.4	21.7	45.1	45.8	27.5	23.4	32.3
16	8.47E+06	(67)	1.24E+07	(98)	32.0	23.1	44.1	49.5	28.3	24.4	32.8
29	5.36E+06	(53)	7.59E+06	(75)	33.1	22.8	47.7	53.6	28.9	25.1	33.2
12	1.05E+07	(69)	1.46E+07	(96)	33.7	24.3	46.3	55.7	29.5	25.8	33.6
1	8.09E+06	(64)	1.13E+07	(89)	33.7	24.0	46.9	59.9	29.9	26.4	34.0
5	6.92E+06	(73)	9.48E+06	(100)	34.2	24.9	46.7	62.9	30.4	27.0	34.3
10	6.07E+06	(60)	8.09E+06	(80)	35.1	24.7	49.7	65.7	30.8	27.4	34.6
27	5.69E+06	(75)	7.51E+06	(99)	35.5	25.9	48.4	67.1	31.2	27.9	34.9
26	1.18E+07	(124)	1.50E+07	(158)	36.7	28.8	46.8	61.7	31.9	28.7	35.5
13	7.18E+06	(71)	9.00E+06	(89)	37.3	26.9	51.6	62.1	32.3	29.1	35.8
14	1.01E+07	(107)	1.26E+07	(133)	37.7	29.0	48.9	59.8	32.7	29.6	36.2
18	1.21E+07	(72)	1.50E+07	(89)	37.9	27.3	52.2	61.1	33.0	29.9	36.4
8	5.92E+06	(39)	7.28E+06	(48)	38.0	24.2	59.2	65.1	33.2	30.1	36.6
7	7.15E+06	(66)	8.78E+06	(81)	38.1	27.1	53.4	67.0	33.4	30.4	36.8
23	6.15E+06	(81)	7.51E+06	(99)	38.3	28.1	51.9	68.1	33.7	30.7	37.0
19	6.07E+06	(48)	7.21E+06	(57)	39.4	26.2	58.8	70.2	33.9	30.8	37.2
2	6.26E+06	(66)	7.40E+06	(78)	39.6	28.0	55.7	70.7	34.1	31.1	37.4
30	8.98E+06	(71)	1.04E+07	(82)	40.5	29.0	56.4	69.9	34.4	31.4	37.6
28	5.67E+06	(56)	6.47E+06	(64)	40.9	28.0	59.5	70.1	34.6	31.6	37.8
6	1.00E+07	(99)	1.09E+07	(108)	42.9	32.5	56.6	62.4	35.0	32.0	38.2
20	9.10E+06	(84)	9.54E+06	(88)	44.6	32.7	60.9	53.8	35.3	32.4	38.6
3	1.55E+07	(92)	1.57E+07	(93)	46.2	34.5	62.0	41.6	35.8	32.8	39.0
9	1.82E+07	(108)	1.77E+07	(105)	48.1	36.5	63.2	25.9	36.3	33.3	39.5
25	3.71E+06	(44)	3.54E+06	(42)	48.9	31.3	76.5	22.9	36.5	33.5	39.8
17	8.30E+06	(82)	7.28E+06	(72)	53.2	38.3	74.1	11.2	37.0	34.0	40.2
POOL	7.31E+06	(2038)	9.25E+06	(2578)				11.2	37.0	34.0	40.2

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 417.7, 21.5

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 37.0, 35.4 -- 38.6 (-1.6 +1.6)
95% CONF. INTERVAL(Ma): 34.0 -- 40.2 (-3.0 +3.3)
REDUCED CHI^2, DEGREES OF FREEDOM: 1.3266, 29
CHI^2 PROBABILITY: 11.2%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 36.9, 35.2 -- 38.6 (-1.6 +1.7)
95% CONF. INTERVAL(Ma): 33.7 -- 40.3 (-3.2 +3.5)
AGE DISPERSION (%): 8.2

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 37.0, 35.4 -- 38.6 (-1.6 +1.6)
95% CONF. INTERVAL (Ma): 34.0 -- 40.2 (-3.0 +3.3)
NUMBER AND PERCENTAGE OF GRAINS: 30, 100%

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:31:00 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1310A.FTZ
WB13-10a, U53Z-15 - 4 November 2013, 14 January 2014
Location: Contact Bay off of entrance to Great Arm
GPS: N 56.67865, W 134.88785
Etch time: 24 hr
Coarse-grained sandstone-graywacke containing quartz, feldspar, and biotite. Beds contain some boundined quartz veins, some of which are folded. Quartz is parallel to schistose fabric.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.727E+05
RELATIVE ERROR (%): 1.70
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U	+/-2s	Grain Age	--95%	CI--
1	1.62E+07	(64)	1.34E+07	(53)	6	605	167	56.4	38.6	82.8
2	5.82E+06	(46)	1.21E+07	(96)	12	548	113	22.5	15.4	32.3
3	7.46E+06	(59)	9.10E+06	(72)	12	411	97	38.4	26.7	54.9
4	8.95E+06	(59)	1.05E+07	(69)	10	472	114	40.1	27.8	57.5
5	6.72E+06	(62)	1.02E+07	(94)	14	460	96	30.9	22.0	43.1
6	4.30E+06	(34)	7.46E+06	(59)	12	337	88	27.1	17.2	41.9
7	4.88E+06	(45)	7.80E+06	(72)	14	352	84	29.3	19.7	43.1
8	5.23E+06	(31)	6.24E+06	(37)	9	281	92	39.3	23.5	65.0
9	7.21E+06	(57)	1.01E+07	(80)	12	456	103	33.4	23.3	47.5
10	6.83E+06	(36)	9.48E+06	(50)	8	428	121	33.8	21.3	52.8
11	5.40E+06	(32)	9.95E+06	(59)	9	449	117	25.5	16.0	39.8
12	4.74E+06	(50)	5.88E+06	(62)	16	265	68	37.8	25.5	55.7
13	5.12E+06	(54)	7.87E+06	(83)	16	355	79	30.5	21.2	43.5
14	3.79E+06	(25)	6.98E+06	(46)	10	315	93	25.6	15.0	42.3
15	8.16E+06	(43)	1.18E+07	(62)	8	530	135	32.5	21.5	48.7
16	9.44E+06	(56)	1.05E+07	(62)	9	472	120	42.3	28.9	61.7
17	6.83E+06	(36)	9.10E+06	(48)	8	411	119	35.2	22.1	55.3
18	8.47E+06	(67)	1.01E+07	(80)	12	456	103	39.2	27.9	55.0
19	1.08E+07	(57)	1.33E+07	(70)	8	599	144	38.2	26.4	54.9
20	4.17E+06	(33)	5.94E+06	(47)	12	268	78	32.9	20.4	52.4
21	7.59E+06	(105)	8.38E+06	(116)	21	378	71	42.4	32.4	55.5
22	7.33E+06	(87)	8.60E+06	(102)	18	388	78	40.0	29.9	53.5
23	1.59E+07	(105)	2.40E+07	(158)	10	1081	176	31.2	24.2	40.2
24	8.53E+06	(118)	1.24E+07	(171)	21	557	87	32.4	25.4	41.2
25	2.55E+07	(151)	1.94E+07	(115)	9	875	165	61.3	47.8	78.6
26	1.14E+07	(150)	8.95E+06	(118)	20	404	75	59.4	46.4	76.0
27	1.53E+07	(101)	1.67E+07	(110)	10	753	146	43.0	32.6	56.6
28	1.53E+07	(151)	1.86E+07	(184)	15	840	127	38.5	30.8	48.1
29	1.28E+07	(118)	1.39E+07	(128)	14	626	112	43.2	33.4	55.8
30	5.36E+06	(53)	7.69E+06	(76)	15	347	80	32.7	22.5	47.0

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:31:00 FILENAME:

C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1310A.FTZ

WB13-10a, U53Z-15 - 4 November 2013, 14 January 2014

Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
2	5.82E+06	(46)	1.21E+07	(96)	22.5	15.4	32.3	100.0	22.5	15.4	32.3
11	5.40E+06	(32)	9.95E+06	(59)	25.5	16.0	39.8	66.2	23.7	17.9	31.2
14	3.79E+06	(25)	6.98E+06	(46)	25.6	15.0	42.3	87.7	24.1	18.9	30.8
6	4.30E+06	(34)	7.46E+06	(59)	27.1	17.2	41.9	92.2	24.7	20.0	30.7
7	4.88E+06	(45)	7.80E+06	(72)	29.3	19.7	43.1	89.5	25.7	21.3	31.1
13	5.12E+06	(54)	7.87E+06	(83)	30.5	21.2	43.5	87.1	26.7	22.5	31.7
5	6.72E+06	(62)	1.02E+07	(94)	30.9	22.0	43.1	87.0	27.5	23.5	32.1
23	1.59E+07	(105)	2.40E+07	(158)	31.2	24.2	40.2	86.4	28.3	24.7	32.5
24	8.53E+06	(118)	1.24E+07	(171)	32.4	25.4	41.2	84.2	29.1	25.7	33.0
15	8.16E+06	(43)	1.18E+07	(62)	32.5	21.5	48.7	88.0	29.4	26.0	33.2
30	5.36E+06	(53)	7.69E+06	(76)	32.7	22.5	47.0	90.7	29.6	26.3	33.3
20	4.17E+06	(33)	5.94E+06	(47)	32.9	20.4	52.4	93.3	29.8	26.5	33.4
9	7.21E+06	(57)	1.01E+07	(80)	33.4	23.3	47.5	94.5	30.0	26.8	33.6
10	6.83E+06	(36)	9.48E+06	(50)	33.8	21.3	52.8	95.9	30.2	27.0	33.7
17	6.83E+06	(36)	9.10E+06	(48)	35.2	22.1	55.3	96.5	30.4	27.3	33.9
12	4.74E+06	(50)	5.88E+06	(62)	37.8	25.5	55.7	94.9	30.8	27.6	34.2
19	1.08E+07	(57)	1.33E+07	(70)	38.2	26.4	54.9	92.7	31.2	28.0	34.6
3	7.46E+06	(59)	9.10E+06	(72)	38.4	26.7	54.9	90.5	31.5	28.4	34.9
28	1.53E+07	(151)	1.86E+07	(184)	38.5	30.8	48.1	80.4	32.3	29.3	35.7
18	8.47E+06	(67)	1.01E+07	(80)	39.2	27.9	55.0	77.9	32.7	29.6	36.0
8	5.23E+06	(31)	6.24E+06	(37)	39.3	23.5	65.0	79.8	32.8	29.8	36.1
22	7.33E+06	(87)	8.60E+06	(102)	40.0	29.9	53.5	75.1	33.2	30.2	36.5
4	8.95E+06	(59)	1.05E+07	(69)	40.1	27.8	57.5	74.2	33.5	30.5	36.7
16	9.44E+06	(56)	1.05E+07	(62)	42.3	28.9	61.7	70.5	33.7	30.8	37.0
21	7.59E+06	(105)	8.38E+06	(116)	42.4	32.4	55.5	60.3	34.2	31.3	37.5
27	1.53E+07	(101)	1.67E+07	(110)	43.0	32.6	56.6	51.0	34.7	31.7	37.9
29	1.28E+07	(118)	1.39E+07	(128)	43.2	33.4	55.8	41.4	35.1	32.2	38.4
1	1.62E+07	(64)	1.34E+07	(53)	56.4	38.6	82.8	18.6	35.6	32.6	38.9
26	1.14E+07	(150)	8.95E+06	(118)	59.4	46.4	76.0	0.7	36.8	33.7	40.1
25	2.55E+07	(151)	1.94E+07	(115)	61.3	47.8	78.6	0.0	37.9	34.8	41.2
POOL	8.55E+06	(2085)	1.06E+07	(2579)				0.0	37.9	34.8	41.2

```
MEAN URANIUM CONCENTRATION +/-2SE (ppm):  477.1,  24.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   37.9,  36.3 --  39.5 (  -1.6   +1.7)
                 95% CONF. INTERVAL(Ma):          34.8 --  41.2 (  -3.1   +3.3)
      REDUCED CHI^2, DEGREES OF FREEDOM:    2.2871,   29
                      CHI^2 PROBABILITY:    0.0%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   37.0,  35.0 --  39.0 (  -2.0   +2.1)
                 95% CONF. INTERVAL(Ma):          33.2 --  41.1 (  -3.8   +4.2)
                     AGE DISPERSION (%):   17.7

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   35.6,  34.1 --  37.2 (  -1.5   +1.6)
                95% CONF. INTERVAL (Ma):          32.6 --  38.9 (  -3.0   +3.2)
        NUMBER AND PERCENTAGE OF GRAINS:   28,    93%
```

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:31:11 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1311A.FTZ
WB13-11a, U53Z-13 - 12 Nov 2013, 12 January 2014
Location: Great Arm, at waterfall on shore
GPS: N 56.70133, W 134.88553
Etch time: 24 hr
Granites with quartz and biotite and pegmatites with quartz, tourmaline, and garnet.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.730E+05
RELATIVE ERROR (%): 1.75
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s		Grain Age	Age (Ma) --95% CI--	
1	1.09E+07	(43)	1.67E+07	(66)	6	752	186	30.6	20.3	45.6
2	1.24E+07	(49)	9.61E+06	(38)	6	433	140	60.3	38.7	94.6
3	1.03E+07	(68)	1.29E+07	(85)	10	581	127	37.5	26.8	52.3
4	1.26E+07	(50)	1.44E+07	(57)	6	650	173	41.1	27.5	61.2
5	1.16E+07	(69)	1.20E+07	(71)	9	539	129	45.5	32.2	64.4
6	1.27E+07	(67)	1.10E+07	(58)	8	496	131	54.1	37.5	78.2
7	9.27E+06	(55)	1.16E+07	(69)	9	524	127	37.4	25.7	54.1
8	8.98E+06	(71)	1.20E+07	(95)	12	541	112	35.1	25.4	48.2
9	1.02E+07	(81)	1.68E+07	(133)	12	758	134	28.6	21.6	38.0
10	9.23E+06	(73)	1.14E+07	(90)	12	513	109	38.0	27.5	52.4
11	1.52E+07	(60)	1.42E+07	(56)	6	638	171	50.2	34.3	73.6
12	1.07E+07	(85)	1.20E+07	(95)	12	541	112	41.9	30.9	56.9
13	8.04E+06	(53)	1.05E+07	(69)	10	472	114	36.0	24.7	52.3
14	9.48E+06	(75)	9.61E+06	(76)	12	433	100	46.2	33.1	64.5
15	9.67E+06	(51)	1.14E+07	(60)	8	513	133	39.9	26.9	58.9
16	1.37E+07	(54)	1.11E+07	(44)	6	501	151	57.4	37.9	87.5
17	9.74E+06	(77)	1.10E+07	(87)	12	496	107	41.5	30.1	57.1
18	1.29E+07	(68)	1.25E+07	(66)	8	564	140	48.3	33.9	68.8
19	1.44E+07	(76)	1.48E+07	(78)	8	667	152	45.7	32.8	63.5
20	8.35E+06	(66)	7.59E+06	(60)	12	342	89	51.5	35.7	74.3
21	1.00E+07	(66)	1.18E+07	(78)	10	533	122	39.7	28.1	55.8
22	8.95E+06	(59)	1.11E+07	(73)	10	499	118	37.9	26.4	54.2
23	1.11E+07	(73)	1.87E+07	(123)	10	841	154	27.9	20.5	37.6
24	7.42E+06	(44)	9.61E+06	(57)	9	433	115	36.2	23.8	54.6
25	9.36E+06	(74)	1.15E+07	(91)	12	518	110	38.1	27.6	52.4
26	1.35E+07	(80)	2.21E+07	(131)	9	995	177	28.7	21.6	38.1
27	9.61E+06	(95)	1.44E+07	(142)	15	647	111	31.4	24.1	41.0
28	1.20E+07	(71)	1.47E+07	(87)	9	661	143	38.3	27.5	53.0
29	1.18E+07	(78)	1.61E+07	(106)	10	725	143	34.5	25.4	46.7
30	8.73E+06	(69)	8.85E+06	(70)	12	399	96	46.2	32.6	65.4

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:31:11 FILENAME:

C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1311A.FTZ

WB13-11a, U53Z-13 - 12 Nov 2013, 12 January 2014

Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
23	1.11E+07	(73)	1.87E+07	(123)	27.9	20.5	37.6	100.0	27.9	20.5	37.6
9	1.02E+07	(81)	1.68E+07	(133)	28.6	21.6	38.0	89.9	28.3	22.9	34.8
26	1.35E+07	(80)	2.21E+07	(131)	28.7	21.6	38.1	98.8	28.4	23.9	33.8
1	1.09E+07	(43)	1.67E+07	(66)	30.6	20.3	45.6	98.6	28.7	24.4	33.7
27	9.61E+06	(95)	1.44E+07	(142)	31.4	24.1	41.0	97.4	29.3	25.4	33.9
29	1.18E+07	(78)	1.61E+07	(106)	34.5	25.4	46.7	91.5	30.1	26.4	34.4
8	8.98E+06	(71)	1.20E+07	(95)	35.1	25.4	48.2	89.0	30.7	27.1	34.9
13	8.04E+06	(53)	1.05E+07	(69)	36.0	24.7	52.3	88.5	31.1	27.6	35.2
24	7.42E+06	(44)	9.61E+06	(57)	36.2	23.8	54.6	89.8	31.5	27.9	35.4
7	9.27E+06	(55)	1.16E+07	(69)	37.4	25.7	54.1	88.6	31.9	28.4	35.8
3	1.03E+07	(68)	1.29E+07	(85)	37.5	26.8	52.3	87.2	32.3	28.9	36.1
22	8.95E+06	(59)	1.11E+07	(73)	37.9	26.4	54.2	87.0	32.7	29.3	36.4
10	9.23E+06	(73)	1.14E+07	(90)	38.0	27.5	52.4	86.4	33.1	29.7	36.8
25	9.36E+06	(74)	1.15E+07	(91)	38.1	27.6	52.4	86.5	33.4	30.1	37.1
28	1.20E+07	(71)	1.47E+07	(87)	38.3	27.5	53.0	87.1	33.7	30.4	37.3
21	1.00E+07	(66)	1.18E+07	(78)	39.7	28.1	55.8	86.5	34.0	30.8	37.6
15	9.67E+06	(51)	1.14E+07	(60)	39.9	26.9	58.9	87.2	34.2	31.0	37.8
4	1.26E+07	(50)	1.44E+07	(57)	41.1	27.5	61.2	87.0	34.5	31.3	38.0
17	9.74E+06	(77)	1.10E+07	(87)	41.5	30.1	57.1	84.4	34.8	31.7	38.3
12	1.07E+07	(85)	1.20E+07	(95)	41.9	30.9	56.9	81.2	35.2	32.1	38.7
5	1.16E+07	(69)	1.20E+07	(71)	45.5	32.2	64.4	73.4	35.6	32.4	39.1
19	1.44E+07	(76)	1.48E+07	(78)	45.7	32.8	63.5	64.9	36.0	32.9	39.5
30	8.73E+06	(69)	8.85E+06	(70)	46.2	32.6	65.4	57.9	36.4	33.2	39.8
14	9.48E+06	(75)	9.61E+06	(76)	46.2	33.1	64.5	51.1	36.7	33.6	40.2
18	1.29E+07	(68)	1.25E+07	(66)	48.3	33.9	68.8	42.9	37.1	33.9	40.5
11	1.52E+07	(60)	1.42E+07	(56)	50.2	34.3	73.6	34.8	37.4	34.3	40.9
20	8.35E+06	(66)	7.59E+06	(60)	51.5	35.7	74.3	25.6	37.8	34.6	41.2
6	1.27E+07	(67)	1.10E+07	(58)	54.1	37.5	78.2	16.0	38.2	35.0	41.7
16	1.37E+07	(54)	1.11E+07	(44)	57.4	37.9	87.5	9.4	38.5	35.4	42.0
2	1.24E+07	(49)	9.61E+06	(38)	60.3	38.7	94.6	5.1	38.9	35.7	42.4
POOL	1.05E+07	(2000)	1.26E+07	(2411)				5.1	38.9	35.7	42.4

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 568.4, 30.5

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 38.9, 37.2 -- 40.6 (-1.7 +1.7)
95% CONF. INTERVAL(Ma): 35.7 -- 42.4 (-3.2 +3.5)
REDUCED CHI^2, DEGREES OF FREEDOM: 1.4655, 29
CHI^2 PROBABILITY: 5.1%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 39.3, 37.4 -- 41.2 (-1.9 +1.9)
95% CONF. INTERVAL(Ma): 35.7 -- 43.2 (-3.6 +3.9)
AGE DISPERSION (%): 11.1

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 38.9, 37.2 -- 40.6 (-1.7 +1.7)
95% CONF. INTERVAL (Ma): 35.7 -- 42.4 (-3.2 +3.5)
NUMBER AND PERCENTAGE OF GRAINS: 30, 100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================

DATE/TIME: 02-04-2014/15:31:25 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1312A.FTZ
WB13-12a, U53Z-11 - 12 January 2014
Location: Great Arm
GPS: N 56.65909, W 134.92255
Etch time: 22 hr
Thinly bedded, coarse-grained sandstones with some interbedded mudstone.

>>NEW PARAMETERS--ZETA METHOD<<

EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.733E+05
RELATIVE ERROR (%): 1.81
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s		Grain Age	Age (Ma) --95% CI--	
1	6.70E+06	(53)	6.45E+06	(51)	12	290	82	48.7	32.5	73.0
2	1.09E+07	(86)	1.20E+07	(95)	12	541	112	42.5	31.3	57.5
3	1.13E+07	(67)	1.23E+07	(73)	9	554	131	43.1	30.4	60.9
4	2.94E+06	(31)	3.60E+06	(38)	16	162	53	38.3	23.0	63.2
5	4.72E+06	(28)	6.91E+06	(41)	9	311	97	32.1	19.1	53.1
6	1.01E+07	(60)	9.10E+06	(54)	9	410	112	52.1	35.4	76.7
7	4.81E+06	(19)	1.01E+07	(40)	6	455	144	22.4	12.2	39.5
8	3.79E+06	(35)	4.34E+06	(40)	14	195	62	41.1	25.3	66.3
9	5.94E+06	(47)	1.21E+07	(96)	12	546	113	23.0	15.9	33.0
10	4.86E+06	(32)	7.59E+06	(50)	10	341	97	30.1	18.7	47.8
11	2.53E+06	(25)	1.42E+06	(14)	15	64	34	83.1	41.9	172.8
12	5.82E+06	(46)	7.84E+06	(62)	12	353	90	34.9	23.2	51.9
13	6.07E+06	(36)	6.91E+06	(41)	9	311	97	41.2	25.6	66.1
14	7.21E+06	(38)	7.59E+06	(40)	8	341	108	44.6	27.8	71.2
15	5.77E+06	(38)	1.14E+07	(75)	10	512	119	23.9	15.7	35.7
16	7.08E+06	(42)	8.77E+06	(52)	9	395	110	37.9	24.6	58.1
17	8.95E+06	(59)	6.83E+06	(45)	10	307	92	61.4	41.0	92.6
18	5.56E+06	(22)	7.59E+06	(30)	6	341	124	34.5	18.9	61.7
19	9.44E+06	(56)	1.20E+07	(71)	9	539	129	37.0	25.6	53.3
20	5.06E+06	(40)	6.70E+06	(53)	12	302	83	35.5	22.9	54.5
21	5.79E+06	(61)	9.67E+06	(102)	16	435	87	28.1	20.1	39.0
22	5.16E+06	(68)	5.92E+06	(78)	20	266	61	40.9	29.1	57.4
23	6.37E+06	(42)	8.50E+06	(56)	10	382	103	35.2	23.0	53.5
24	7.97E+06	(63)	1.37E+07	(108)	12	615	120	27.4	19.7	37.8
25	3.60E+06	(38)	5.97E+06	(63)	16	269	68	28.4	18.4	43.1
26	1.15E+07	(68)	1.28E+07	(76)	9	577	134	42.0	29.8	59.1
27	6.43E+06	(89)	5.06E+06	(70)	21	228	55	59.5	43.0	82.7
28	1.54E+07	(81)	1.90E+07	(100)	8	854	173	38.0	28.0	51.5
29	8.54E+06	(90)	1.37E+07	(144)	16	615	105	29.4	22.5	38.5
30	3.57E+06	(47)	4.63E+06	(61)	20	208	54	36.2	24.2	53.8

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:31:25 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1312A.FTZ

WB13-12a, U53Z-11 - 12 January 2014

Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
7	4.81E+06	(19)	1.01E+07	(40)	22.4	12.2	39.5	100.0	22.4	12.2	39.5
9	5.94E+06	(47)	1.21E+07	(96)	23.0	15.9	33.0	92.7	22.8	16.7	30.9
15	5.77E+06	(38)	1.14E+07	(75)	23.9	15.7	35.7	98.1	23.2	18.2	29.6
24	7.97E+06	(63)	1.37E+07	(108)	27.4	19.7	37.8	86.0	24.6	20.2	30.0
21	5.79E+06	(61)	9.67E+06	(102)	28.1	20.1	39.0	87.0	25.5	21.4	30.3
25	3.60E+06	(38)	5.97E+06	(63)	28.4	18.4	43.1	91.5	25.8	22.0	30.4
29	8.54E+06	(90)	1.37E+07	(144)	29.4	22.5	38.5	90.4	26.6	23.1	30.8
10	4.86E+06	(32)	7.59E+06	(50)	30.1	18.7	47.8	93.3	26.9	23.4	30.9
5	4.72E+06	(28)	6.91E+06	(41)	32.1	19.1	53.1	94.0	27.2	23.7	31.2
18	5.56E+06	(22)	7.59E+06	(30)	34.5	18.9	61.7	93.7	27.5	24.0	31.4
12	5.82E+06	(46)	7.84E+06	(62)	34.9	23.2	51.9	89.6	28.0	24.7	31.9
23	6.37E+06	(42)	8.50E+06	(56)	35.2	23.0	53.5	86.8	28.5	25.2	32.3
20	5.06E+06	(40)	6.70E+06	(53)	35.5	22.9	54.5	85.3	28.9	25.6	32.7
30	3.57E+06	(47)	4.63E+06	(61)	36.2	24.2	53.8	82.3	29.4	26.1	33.1
19	9.44E+06	(56)	1.20E+07	(71)	37.0	25.6	53.3	77.4	29.9	26.6	33.5
16	7.08E+06	(42)	8.77E+06	(52)	37.9	24.6	58.1	74.7	30.3	27.0	33.9
28	1.54E+07	(81)	1.90E+07	(100)	38.0	28.0	51.5	66.1	30.9	27.7	34.5
4	2.94E+06	(31)	3.60E+06	(38)	38.3	23.0	63.2	67.3	31.1	27.9	34.7
22	5.16E+06	(68)	5.92E+06	(78)	40.9	29.1	57.4	56.3	31.7	28.5	35.2
8	3.79E+06	(35)	4.34E+06	(40)	41.1	25.3	66.3	54.8	32.0	28.8	35.5
13	6.07E+06	(36)	6.91E+06	(41)	41.2	25.6	66.1	53.5	32.2	29.1	35.8
26	1.15E+07	(68)	1.28E+07	(76)	42.0	29.8	59.1	45.2	32.8	29.6	36.2
2	1.09E+07	(86)	1.20E+07	(95)	42.5	31.3	57.5	35.1	33.3	30.2	36.8
3	1.13E+07	(67)	1.23E+07	(73)	43.1	30.4	60.9	29.8	33.8	30.6	37.2
14	7.21E+06	(38)	7.59E+06	(40)	44.6	27.8	71.2	28.1	34.0	30.9	37.5
1	6.70E+06	(53)	6.45E+06	(51)	48.7	32.5	73.0	19.7	34.5	31.3	37.9
6	1.01E+07	(60)	9.10E+06	(54)	52.1	35.4	76.7	10.2	35.0	31.8	38.5
27	6.43E+06	(89)	5.06E+06	(70)	59.5	43.0	82.7	1.2	35.9	32.7	39.4
17	8.95E+06	(59)	6.83E+06	(45)	61.4	41.0	92.6	0.3	36.5	33.3	40.1
11	2.53E+06	(25)	1.42E+06	(14)	83.1	41.9	172.8	0.1	36.9	33.6	40.4
POOL	6.41E+06	(1507)	8.16E+06	(1919)				0.1	36.9	33.6	40.4

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 367.1, 21.4

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 36.9, 35.2 -- 38.6 (-1.7 +1.8)
95% CONF. INTERVAL(Ma): 33.6 -- 40.4 (-3.2 +3.6)
REDUCED CHI^2, DEGREES OF FREEDOM: 2.0632, 29
CHI^2 PROBABILITY: 0.1%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 37.1, 35.0 -- 39.4 (-2.1 +2.2)
95% CONF. INTERVAL(Ma): 33.1 -- 41.6 (-4.0 +4.5)
AGE DISPERSION (%): 18.5

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 35.9, 34.2 -- 37.7 (-1.7 +1.8)
95% CONF. INTERVAL (Ma): 32.7 -- 39.4 (-3.2 +3.5)
NUMBER AND PERCENTAGE OF GRAINS: 28, 93%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-04-2014/15:31:53 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1314A.FTZ
WB13-14a, U53Z-09 - 14 Nov 2013, 12 January 2014
Location: end of Small Arm
GPS: N 56.71730, W 134.95386
Etch time: 18.25 hr
Granodiorites with quartz, feldspar, biotite, and hornblende.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.737E+05
RELATIVE ERROR (%): 1.87
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07
------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U	+/-2s	Grain Age	Age (Ma) --95% CI--	
1	7.71E+06	(61)	1.04E+07	(82)	12	466	104	35.0	24.7	49.4
2	8.09E+06	(48)	1.23E+07	(73)	9	553	131	31.0	21.0	45.2
3	5.44E+06	(43)	8.73E+06	(69)	12	392	95	29.4	19.5	43.6
4	6.07E+06	(60)	1.03E+07	(102)	15	464	93	27.7	19.7	38.5
5	4.81E+06	(38)	6.32E+06	(50)	12	284	81	35.8	22.8	55.6
6	9.29E+06	(49)	1.31E+07	(69)	8	588	143	33.4	22.7	48.9
7	6.70E+06	(53)	1.28E+07	(101)	12	574	116	24.7	17.3	34.8
8	4.93E+06	(39)	6.45E+06	(51)	12	290	81	36.0	23.1	55.7
9	1.02E+07	(67)	1.24E+07	(82)	10	559	125	38.4	27.4	53.8
10	5.44E+06	(43)	5.31E+06	(42)	12	239	74	48.1	30.7	75.4
11	1.04E+07	(55)	1.38E+07	(73)	8	622	147	35.5	24.5	51.0
12	5.31E+06	(28)	7.21E+06	(38)	8	324	105	34.7	20.5	58.0
13	1.32E+07	(52)	8.85E+06	(35)	6	398	134	69.6	44.5	110.1
14	6.07E+06	(48)	7.46E+06	(59)	12	335	88	38.3	25.6	57.0
15	9.27E+06	(55)	1.10E+07	(65)	9	493	123	39.8	27.2	57.9
16	5.31E+06	(35)	1.06E+07	(70)	10	477	115	23.6	15.2	35.8
17	9.86E+06	(65)	8.95E+06	(59)	10	402	105	51.7	35.8	74.9
18	6.88E+06	(68)	7.08E+06	(70)	15	318	77	45.7	32.2	64.7
19	8.47E+06	(67)	9.74E+06	(77)	12	438	101	40.9	29.0	57.6
20	1.05E+07	(62)	1.01E+07	(60)	9	455	118	48.5	33.5	70.4
21	4.10E+06	(54)	4.40E+06	(58)	20	198	52	43.8	29.6	64.5
22	4.99E+06	(69)	8.38E+06	(116)	21	377	71	28.0	20.4	38.1
23	4.84E+06	(51)	9.77E+06	(103)	16	439	88	23.3	16.3	33.0
24	6.27E+06	(62)	7.38E+06	(73)	15	332	78	39.9	28.0	56.8
25	4.68E+06	(37)	1.09E+07	(86)	12	489	107	20.3	13.4	30.1
26	4.10E+06	(54)	6.07E+06	(80)	20	273	62	31.8	22.0	45.5
27	4.32E+06	(57)	9.10E+06	(120)	20	409	76	22.4	16.0	31.0
28	5.22E+06	(55)	7.87E+06	(83)	16	354	79	31.2	21.7	44.4
29	5.06E+06	(40)	6.20E+06	(49)	12	278	80	38.4	24.6	59.5
30	4.55E+06	(27)	5.73E+06	(34)	9	258	88	37.4	21.7	63.7

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:31:53 FILENAME:

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WB13-14a, U53Z-09 - 14 Nov 2013, 12 January 2014

Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
25	4.68E+06	(37)	1.09E+07	(86)	20.3	13.4	30.1	100.0	20.3	13.4	30.1
27	4.32E+06	(57)	9.10E+06	(120)	22.4	16.0	31.0	69.7	21.5	16.8	27.7
23	4.84E+06	(51)	9.77E+06	(103)	23.3	16.3	33.0	86.1	22.1	18.0	27.2
16	5.31E+06	(35)	1.06E+07	(70)	23.6	15.2	35.8	94.6	22.4	18.5	27.0
7	6.70E+06	(53)	1.28E+07	(101)	24.7	17.3	34.8	95.8	22.9	19.3	27.1
4	6.07E+06	(60)	1.03E+07	(102)	27.7	19.7	38.5	88.1	23.7	20.3	27.7
22	4.99E+06	(69)	8.38E+06	(116)	28.0	20.4	38.1	84.2	24.4	21.2	28.1
3	5.44E+06	(43)	8.73E+06	(69)	29.4	19.5	43.6	83.3	24.9	21.7	28.5
2	8.09E+06	(48)	1.23E+07	(73)	31.0	21.0	45.2	78.3	25.4	22.3	28.9
28	5.22E+06	(55)	7.87E+06	(83)	31.2	21.7	44.4	74.1	25.9	22.9	29.4
26	4.10E+06	(54)	6.07E+06	(80)	31.8	22.0	45.5	70.8	26.4	23.4	29.8
6	9.29E+06	(49)	1.31E+07	(69)	33.4	22.7	48.9	65.4	26.8	23.8	30.2
12	5.31E+06	(28)	7.21E+06	(38)	34.7	20.5	58.0	64.6	27.1	24.1	30.4
1	7.71E+06	(61)	1.04E+07	(82)	35.0	24.7	49.4	55.0	27.6	24.7	30.9
11	1.04E+07	(55)	1.38E+07	(73)	35.5	24.5	51.0	48.7	28.1	25.2	31.4
5	4.81E+06	(38)	6.32E+06	(50)	35.8	22.8	55.6	47.5	28.4	25.5	31.6
8	4.93E+06	(39)	6.45E+06	(51)	36.0	23.1	55.7	46.4	28.7	25.7	31.9
30	4.55E+06	(27)	5.73E+06	(34)	37.4	21.7	63.7	46.5	28.9	26.0	32.1
14	6.07E+06	(48)	7.46E+06	(59)	38.3	25.6	57.0	40.3	29.2	26.3	32.5
29	5.06E+06	(40)	6.20E+06	(49)	38.4	24.6	59.5	37.4	29.5	26.6	32.8
9	1.02E+07	(67)	1.24E+07	(82)	38.4	27.4	53.8	30.4	30.0	27.1	33.2
15	9.27E+06	(55)	1.10E+07	(65)	39.8	27.2	57.9	25.1	30.4	27.5	33.6
24	6.27E+06	(62)	7.38E+06	(73)	39.9	28.0	56.8	20.2	30.8	27.9	34.0
19	8.47E+06	(67)	9.74E+06	(77)	40.9	29.0	57.6	15.1	31.2	28.3	34.4
21	4.10E+06	(54)	4.40E+06	(58)	43.8	29.6	64.5	10.4	31.6	28.7	34.8
18	6.88E+06	(68)	7.08E+06	(70)	45.7	32.2	64.7	5.3	32.1	29.2	35.3
10	5.44E+06	(43)	5.31E+06	(42)	48.1	30.7	75.4	3.3	32.5	29.6	35.6
20	1.05E+07	(62)	1.01E+07	(60)	48.5	33.5	70.4	1.4	32.9	30.0	36.1
17	9.86E+06	(65)	8.95E+06	(59)	51.7	35.8	74.9	0.4	33.5	30.5	36.7
13	1.32E+07	(52)	8.85E+06	(35)	69.6	44.5	110.1	0.0	34.1	31.1	37.3
POOL	6.26E+06	(1542)	8.64E+06	(2129)				0.0	34.1	31.1	37.3

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 388.2, 22.2

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 34.1, 32.5 -- 35.7 (-1.6 +1.6)
95% CONF. INTERVAL(Ma): 31.1 -- 37.3 (-3.0 +3.3)
REDUCED CHI^2, DEGREES OF FREEDOM: 2.1724, 29
CHI^2 PROBABILITY: 0.0%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 34.6, 32.6 -- 36.6 (-2.0 +2.1)
95% CONF. INTERVAL(Ma): 30.8 -- 38.7 (-3.7 +4.2)
AGE DISPERSION (%): 19.2

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 32.9, 31.4 -- 34.5 (-1.5 +1.6)
95% CONF. INTERVAL (Ma): 30.0 -- 36.1 (-2.9 +3.2)
NUMBER AND PERCENTAGE OF GRAINS: 28, 93%

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:32:02 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1315A.FTZ
WB13-15a, U53Z-07 - 19 Nov 2013, 12 January 2014
Location: Small Arm
GPS: N 56.70247, W 134.98312
Etch time: 24 hr
Medium- to coarse-grained, foliated graywacke-sandstones with quartz veins.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.740E+05
RELATIVE ERROR (%): 1.93
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U	+/-2s	Grain Age	Age (Ma) --95% CI--	
1	5.22E+06	(55)	7.21E+06	(76)	16	324	75	34.1	23.6	48.9
2	5.31E+06	(42)	6.45E+06	(51)	12	290	81	38.8	25.1	59.5
3	3.13E+06	(33)	5.22E+06	(55)	16	234	64	28.3	17.8	44.3
4	6.95E+06	(55)	8.47E+06	(67)	12	380	94	38.7	26.5	56.1
5	7.33E+06	(58)	1.16E+07	(92)	12	522	110	29.7	21.0	41.8
6	7.71E+06	(61)	9.86E+06	(78)	12	443	101	36.8	25.9	52.2
7	8.50E+06	(56)	1.29E+07	(85)	10	579	127	31.1	21.7	44.0
8	4.74E+06	(25)	9.10E+06	(48)	8	409	118	24.6	14.5	40.6
9	5.44E+06	(43)	1.01E+07	(80)	12	454	103	25.4	17.0	37.2
10	6.45E+06	(51)	7.21E+06	(57)	12	324	86	42.1	28.3	62.6
11	7.44E+06	(49)	8.19E+06	(54)	10	368	101	42.7	28.4	64.1
12	1.62E+06	(16)	2.53E+06	(25)	15	114	45	30.3	15.0	58.7
13	9.23E+06	(73)	1.30E+07	(103)	12	585	117	33.4	24.3	45.6
14	6.83E+06	(54)	1.30E+07	(103)	12	585	117	24.7	17.4	34.7
15	1.20E+07	(95)	1.43E+07	(113)	12	641	123	39.6	30.0	52.3
16	5.82E+06	(46)	8.85E+06	(70)	12	397	96	31.0	20.8	45.6
17	7.71E+06	(61)	1.18E+07	(93)	12	528	111	30.9	22.0	43.2
18	9.26E+06	(61)	1.32E+07	(87)	10	593	129	33.0	23.4	46.4
19	7.21E+06	(57)	5.82E+06	(46)	12	261	77	58.2	38.8	87.8
20	7.84E+06	(62)	1.04E+07	(82)	12	465	104	35.6	25.1	50.2
21	3.24E+06	(32)	4.75E+06	(47)	15	213	62	32.1	19.8	51.3
22	4.74E+06	(25)	1.04E+07	(55)	8	468	127	21.5	12.8	35.0
23	9.41E+06	(62)	1.17E+07	(77)	10	525	121	37.9	26.6	53.7
24	1.21E+07	(72)	1.03E+07	(61)	9	462	119	55.5	38.9	79.4
25	6.70E+06	(53)	8.85E+06	(70)	12	397	96	35.7	24.4	51.7
26	8.67E+05	(8)	1.41E+06	(13)	14	63	35	29.2	10.4	75.3
27	2.58E+06	(34)	3.49E+06	(46)	20	157	46	34.8	21.6	55.4
28	3.34E+06	(44)	4.17E+06	(55)	20	187	51	37.7	24.7	57.0
29	4.43E+06	(35)	8.98E+06	(71)	12	403	97	23.3	15.0	35.3
30	8.85E+06	(70)	1.29E+07	(102)	12	579	117	32.3	23.5	44.3

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:32:02 FILENAME:

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WB13-15a, U53Z-07 - 19 Nov 2013, 12 January 2014

Number of grains = 30

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
22	4.74E+06	(25)	1.04E+07	(55)	21.5	12.8	35.0	100.0	21.5	12.8	35.0
29	4.43E+06	(35)	8.98E+06	(71)	23.3	15.0	35.3	79.8	22.5	16.2	30.8
8	4.74E+06	(25)	9.10E+06	(48)	24.6	14.5	40.6	92.4	23.1	17.7	30.1
14	6.83E+06	(54)	1.30E+07	(103)	24.7	17.4	34.7	96.6	23.7	19.1	29.3
9	5.44E+06	(43)	1.01E+07	(80)	25.4	17.0	37.2	98.5	24.0	19.9	29.1
3	3.13E+06	(33)	5.22E+06	(55)	28.3	17.8	44.3	97.5	24.6	20.6	29.4
26	8.67E+05	(8)	1.41E+06	(13)	29.2	10.4	75.3	98.7	24.7	20.8	29.4
5	7.33E+06	(58)	1.16E+07	(92)	29.7	21.0	41.8	96.4	25.6	21.9	30.0
12	1.62E+06	(16)	2.53E+06	(25)	30.3	15.0	58.7	97.6	25.8	22.1	30.2
17	7.71E+06	(61)	1.18E+07	(93)	30.9	22.0	43.2	95.8	26.6	23.0	30.7
16	5.82E+06	(46)	8.85E+06	(70)	31.0	20.8	45.6	95.9	27.0	23.5	31.0
7	8.50E+06	(56)	1.29E+07	(85)	31.1	21.7	44.0	96.1	27.4	24.1	31.3
21	3.24E+06	(32)	4.75E+06	(47)	32.1	19.8	51.3	96.7	27.7	24.4	31.5
30	8.85E+06	(70)	1.29E+07	(102)	32.3	23.5	44.3	96.1	28.2	24.9	31.9
18	9.26E+06	(61)	1.32E+07	(87)	33.0	23.4	46.4	95.7	28.6	25.4	32.2
13	9.23E+06	(73)	1.30E+07	(103)	33.4	24.3	45.6	95.0	29.0	25.9	32.5
1	5.22E+06	(55)	7.21E+06	(76)	34.1	23.6	48.9	94.9	29.4	26.3	32.8
27	2.58E+06	(34)	3.49E+06	(46)	34.8	21.6	55.4	95.4	29.6	26.5	33.0
20	7.84E+06	(62)	1.04E+07	(82)	35.6	25.1	50.2	94.2	29.9	26.9	33.3
25	6.70E+06	(53)	8.85E+06	(70)	35.7	24.4	51.7	93.9	30.2	27.2	33.6
6	7.71E+06	(61)	9.86E+06	(78)	36.8	25.9	52.2	92.4	30.6	27.6	33.9
28	3.34E+06	(44)	4.17E+06	(55)	37.7	24.7	57.0	91.6	30.8	27.8	34.1
23	9.41E+06	(62)	1.17E+07	(77)	37.9	26.6	53.7	89.6	31.2	28.2	34.4
4	6.95E+06	(55)	8.47E+06	(67)	38.7	26.5	56.1	87.7	31.4	28.5	34.7
2	5.31E+06	(42)	6.45E+06	(51)	38.8	25.1	59.5	87.2	31.7	28.7	34.9
15	1.20E+07	(95)	1.43E+07	(113)	39.6	30.0	52.3	80.7	32.1	29.2	35.4
10	6.45E+06	(51)	7.21E+06	(57)	42.1	28.3	62.6	75.9	32.4	29.5	35.7
11	7.44E+06	(49)	8.19E+06	(54)	42.7	28.4	64.1	71.0	32.7	29.8	36.0
24	1.21E+07	(72)	1.03E+07	(61)	55.5	38.9	79.4	29.5	33.4	30.4	36.7
19	7.21E+06	(57)	5.82E+06	(46)	58.2	38.8	87.8	9.6	34.0	31.0	37.3
POOL	6.05E+06	(1488)	8.39E+06	(2062)				9.6	34.0	31.0	37.3

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 376.6, 22.1

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 34.0, 32.4 -- 35.6 (-1.6 +1.6)
95% CONF. INTERVAL(Ma): 31.0 -- 37.3 (-3.0 +3.3)
REDUCED CHI^2, DEGREES OF FREEDOM: 1.3545, 29
CHI^2 PROBABILITY: 9.6%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 33.9, 32.2 -- 35.7 (-1.7 +1.8)
95% CONF. INTERVAL(Ma): 30.7 -- 37.5 (-3.3 +3.6)
AGE DISPERSION (%): 10.7

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 34.0, 32.4 -- 35.6 (-1.6 +1.6)
95% CONF. INTERVAL (Ma): 31.0 -- 37.3 (-3.0 +3.3)
NUMBER AND PERCENTAGE OF GRAINS: 30, 100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:32:13 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1316A.FTZ
WB13-16a, U53Z-05 - 6-8 January 2014
Location: Point of Rakovoi Bay, Whale Bay
GPS: N 56.60297, W 134.96886
Etch time: 22 hr
Medium- to coarse-grained graywacke-sandstones with interbedded shale.
Coarsening of grains in sandstone indicates up direction.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.743E+05
RELATIVE ERROR (%): 2.00
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 344.50 9.20
SIZE OF COUNTER SQUARE (cm^2): 6.590E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U	+/-2s	Grain Age	--95% CI--	
1	9.10E+06	(48)	6.83E+06	(36)	8	306	102	62.6	39.9	99.3
2	7.97E+06	(63)	8.22E+06	(65)	12	369	92	45.6	31.7	65.6
3	9.74E+06	(77)	1.20E+07	(95)	12	539	112	38.2	27.9	52.2
4	5.31E+06	(35)	6.37E+06	(42)	10	286	88	39.3	24.3	63.0
5	4.46E+06	(47)	5.22E+06	(55)	16	234	63	40.3	26.7	60.6
6	5.69E+06	(45)	6.70E+06	(53)	12	301	83	40.0	26.2	60.7
7	5.06E+06	(40)	7.71E+06	(61)	12	346	89	31.0	20.2	46.9
8	6.20E+06	(49)	8.60E+06	(68)	12	386	94	34.0	23.0	49.8
9	7.28E+06	(48)	1.23E+07	(81)	10	551	124	28.0	19.1	40.5
10	3.67E+06	(29)	5.31E+06	(42)	12	238	74	32.6	19.5	53.5
11	7.42E+06	(44)	1.05E+07	(62)	9	469	120	33.5	22.2	50.1
12	4.34E+06	(40)	5.74E+06	(53)	14	258	71	35.6	23.0	54.7
13	5.18E+06	(41)	8.60E+06	(68)	12	386	94	28.5	18.8	42.5
14	7.33E+06	(58)	9.86E+06	(78)	12	442	101	35.1	24.5	49.9
15	8.24E+06	(76)	1.46E+07	(135)	14	656	116	26.6	20.0	35.5
16	1.05E+07	(62)	1.40E+07	(83)	9	628	140	35.2	24.9	49.6
17	9.48E+06	(75)	7.97E+06	(63)	12	357	91	56.0	39.5	79.6
18	7.97E+06	(63)	1.15E+07	(91)	12	516	110	32.7	23.2	45.6
19	9.29E+06	(98)	9.39E+06	(99)	16	421	86	46.6	35.0	62.0
20	7.78E+06	(82)	9.20E+06	(97)	16	413	85	39.8	29.3	54.1
21	5.39E+06	(71)	9.86E+06	(130)	20	442	79	25.8	19.0	34.7
22	5.23E+06	(62)	6.32E+06	(75)	18	284	66	39.0	27.3	55.3
23	6.17E+06	(61)	7.28E+06	(72)	15	327	78	39.9	27.9	57.0
24	9.74E+06	(77)	7.33E+06	(58)	12	329	87	62.4	43.8	89.4
25	5.26E+06	(52)	7.38E+06	(73)	15	331	78	33.6	23.0	48.6
26	5.06E+06	(60)	6.32E+06	(75)	18	284	66	37.7	26.3	53.7
27	7.30E+06	(77)	8.73E+06	(92)	16	391	83	39.4	28.7	54.0
28	7.81E+06	(103)	7.13E+06	(94)	20	320	67	51.5	38.7	68.5
29	4.25E+06	(70)	4.86E+06	(80)	25	218	49	41.2	29.4	57.6
30	1.29E+07	(68)	1.37E+07	(72)	8	612	146	44.5	31.4	62.9

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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:32:13 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1316A.FTZ
WB13-16a, U53Z-05 - 6-8 January 2014
Number of grains =  30
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)    Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 21  5.39E+06 (  71) 9.86E+06 ( 130)  25.8  19.0  34.7 100.0   25.8  19.0  34.7
 15  8.24E+06 (  76) 1.46E+07 ( 135)  26.6  20.0  35.5  88.3   26.2  21.2  32.4
  9  7.28E+06 (  48) 1.23E+07 (  81)  28.0  19.1  40.5  94.1   26.6  22.1  32.1
 13  5.18E+06 (  41) 8.60E+06 (  68)  28.5  18.8  42.5  97.5   26.9  22.6  32.0
  7  5.06E+06 (  40) 7.71E+06 (  61)  31.0  20.2  46.9  96.0   27.4  23.3  32.2
 10  3.67E+06 (  29) 5.31E+06 (  42)  32.6  19.5  53.5  95.5   27.8  23.8  32.5
 18  7.97E+06 (  63) 1.15E+07 (  91)  32.7  23.2  45.6  93.0   28.5  24.7  33.0
 11  7.42E+06 (  44) 1.05E+07 (  62)  33.5  22.2  50.1  93.0   29.0  25.2  33.3
 25  5.26E+06 (  52) 7.38E+06 (  73)  33.6  23.0  48.6  93.2   29.5  25.8  33.6
  8  6.20E+06 (  49) 8.60E+06 (  68)  34.0  23.0  49.8  93.8   29.8  26.2  33.9
 14  7.33E+06 (  58) 9.86E+06 (  78)  35.1  24.5  49.9  93.1   30.3  26.8  34.3
 16  1.05E+07 (  62) 1.40E+07 (  83)  35.2  24.9  49.6  92.8   30.7  27.3  34.6
 12  4.34E+06 (  40) 5.74E+06 (  53)  35.6  23.0  54.7  93.8   31.0  27.5  34.8
 26  5.06E+06 (  60) 6.32E+06 (  75)  37.7  26.3  53.7  91.7   31.4  28.0  35.2
  3  9.74E+06 (  77) 1.20E+07 (  95)  38.2  27.9  52.2  88.0   32.0  28.6  35.7
 22  5.23E+06 (  62) 6.32E+06 (  75)  39.0  27.3  55.3  85.5   32.4  29.1  36.1
  4  5.31E+06 (  35) 6.37E+06 (  42)  39.3  24.3  63.0  86.2   32.6  29.3  36.3
 27  7.30E+06 (  77) 8.73E+06 (  92)  39.4  28.7  54.0  83.0   33.0  29.8  36.7
 20  7.78E+06 (  82) 9.20E+06 (  97)  39.8  29.3  54.1  79.6   33.5  30.2  37.1
 23  6.17E+06 (  61) 7.28E+06 (  72)  39.9  27.9  57.0  79.1   33.8  30.5  37.3
  6  5.69E+06 (  45) 6.70E+06 (  53)  40.0  26.2  60.7  80.2   34.0  30.8  37.5
  5  4.46E+06 (  47) 5.22E+06 (  55)  40.3  26.7  60.6  81.1   34.2  31.0  37.7
 29  4.25E+06 (  70) 4.86E+06 (  80)  41.2  29.4  57.6  79.2   34.5  31.3  38.0
 30  1.29E+07 (  68) 1.37E+07 (  72)  44.5  31.4  62.9  72.3   34.9  31.7  38.4
  2  7.97E+06 (  63) 8.22E+06 (  65)  45.6  31.7  65.6  64.8   35.3  32.1  38.8
 19  9.29E+06 (  98) 9.39E+06 (  99)  46.6  35.0  62.0  49.4   35.8  32.6  39.3
 28  7.81E+06 ( 103) 7.13E+06 (  94)  51.5  38.7  68.5  24.1   36.5  33.3  40.0
 17  9.48E+06 (  75) 7.97E+06 (  63)  56.0  39.5  79.6  10.0   37.1  33.9  40.6
 24  9.74E+06 (  77) 7.33E+06 (  58)  62.4  43.8  89.4   1.9   37.8  34.5  41.3
  1  9.10E+06 (  48) 6.83E+06 (  36)  62.6  39.9  99.3   0.7   38.2  34.9  41.7
POOL 6.76E+06( 1821) 8.34E+06( 2248)                     0.7   38.2  34.9  41.7

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  374.0,  21.7

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   38.2,  36.5 --  39.9 (  -1.7   +1.8)
                95% CONF. INTERVAL(Ma):          34.9 --  41.7 (  -3.3   +3.6)
      REDUCED CHI^2, DEGREES OF FREEDOM:    1.7539,   29
                     CHI^2 PROBABILITY:    0.7%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   38.2,  36.3 --  40.3 (  -2.0   +2.1)
                95% CONF. INTERVAL(Ma):          34.5 --  42.4 (  -3.8   +4.2)
                    AGE DISPERSION (%):   14.5

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   37.8,  36.1 --  39.5 (  -1.7   +1.8)
               95% CONF. INTERVAL (Ma):          34.5 --  41.3 (  -3.3   +3.6)
        NUMBER AND PERCENTAGE OF GRAINS:   29,    97%
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===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-04-2014/15:32:22 FILENAME:
C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1317B.FTZ
WB13-17b, U53Z-02 - 30 January 2014
Location: Between Middle Channel and Walker Channel
GPS: N 56.74026, W 135.19830
Etch time: 21.75 hr
Medium- to thick-bedded turbidite sandstone unit.

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.748E+05
                                       RELATIVE ERROR (%):      2.11
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    344.50     9.20
                            SIZE OF COUNTER SQUARE (cm^2):      6.590E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                          Age     --95% CI--
   1   8.73E+06 (  69)  1.07E+07 (  85)   12    481 106   38.3   27.4   53.4
   2   1.26E+07 ( 100)  1.39E+07 ( 110)   12    623 121   42.9   32.5   56.6
   3   1.57E+07 (  62)  1.92E+07 (  76)    6    860 200   38.5   27.0   54.7
   4   7.59E+06 (  45)  6.24E+06 (  37)    9    279  92   57.3   36.3   91.0
   5   1.23E+07 (  65)  1.21E+07 (  64)    8    543 137   47.9   33.3   68.8
   6   4.30E+06 (  34)  4.93E+06 (  39)   12    221  71   41.2   25.2   66.9
   7   9.61E+06 (  76)  1.25E+07 (  99)   12    560 115   36.3   26.5   49.5
   8   3.60E+06 (  38)  5.69E+06 (  60)   16    255  66   30.0   19.4   45.7
   9   1.07E+07 ( 113)  1.10E+07 ( 116)   16    492  94   46.0   35.2   59.9
  10   1.82E+07 (  96)  1.35E+07 (  71)    8    603 145   63.7   46.3   87.9
  11   1.43E+07 ( 113)  1.63E+07 ( 129)   12    730 132   41.4   31.9   53.6
  12   2.73E+06 (  45)  4.67E+06 (  77)   25    209  48   27.7   18.6   40.5
  13   6.32E+06 (  50)  9.61E+06 (  76)   12    430 100   31.1   21.3   45.1
  14   9.10E+06 (  54)  1.65E+07 (  98)    9    740 152   26.1   18.3   36.7
  15   8.35E+06 (  88)  9.86E+06 ( 104)   16    441  88   40.0   29.9   53.4
  16   5.94E+06 (  47)  9.36E+06 (  74)   12    419  99   30.0   20.3   43.9
  17   1.03E+07 (  68)  1.70E+07 ( 112)   10    761 147   28.7   20.9   39.2
  18   4.38E+06 (  52)  4.81E+06 (  57)   18    215  57   43.1   28.9   63.9
  19   1.35E+07 (  80)  1.69E+07 ( 100)    9    755 154   37.8   27.7   51.3
  20   8.82E+06 (  93)  1.02E+07 ( 108)   16    458  90   40.7   30.6   54.0
  21   8.98E+06 (  71)  1.48E+07 ( 117)   12    662 125   28.7   21.0   38.9
```

===================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================

DATE/TIME: 02-04-2014/15:32:22 FILENAME:

C:\USERS\SENTERRA\DESKTOP\FTFOLD~1\KATE\UNKNOWNS\WB1317B.FTZ

WB13-17b, U53Z-02 - 30 January 2014

Number of grains = 21

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
14	9.10E+06	(54)	1.65E+07	(98)	26.1	18.3	36.7	100.0	26.1	18.3	36.7
12	2.73E+06	(45)	4.67E+06	(77)	27.7	18.6	40.5	81.6	26.8	20.8	34.5
21	8.98E+06	(71)	1.48E+07	(117)	28.7	21.0	38.9	91.3	27.5	22.5	33.6
17	1.03E+07	(68)	1.70E+07	(112)	28.7	20.9	39.2	97.2	27.8	23.4	33.1
8	3.60E+06	(38)	5.69E+06	(60)	30.0	19.4	45.7	98.7	28.1	23.9	33.1
16	5.94E+06	(47)	9.36E+06	(74)	30.0	20.3	43.9	99.4	28.4	24.4	33.1
13	6.32E+06	(50)	9.61E+06	(76)	31.1	21.3	45.1	99.5	28.7	24.8	33.2
7	9.61E+06	(76)	1.25E+07	(99)	36.3	26.5	49.5	91.5	29.8	26.0	34.1
19	1.35E+07	(80)	1.69E+07	(100)	37.8	27.7	51.3	77.6	30.7	27.0	34.9
1	8.73E+06	(69)	1.07E+07	(85)	38.3	27.4	53.4	69.1	31.5	27.8	35.6
3	1.57E+07	(62)	1.92E+07	(76)	38.5	27.0	54.7	65.4	32.0	28.4	36.0
15	8.35E+06	(88)	9.86E+06	(104)	40.0	29.9	53.4	54.7	32.8	29.2	36.7
20	8.82E+06	(93)	1.02E+07	(108)	40.7	30.6	54.0	45.6	33.5	30.0	37.4
6	4.30E+06	(34)	4.93E+06	(39)	41.2	25.2	66.9	47.8	33.7	30.2	37.6
11	1.43E+07	(113)	1.63E+07	(129)	41.4	31.9	53.6	39.1	34.5	31.0	38.3
2	1.26E+07	(100)	1.39E+07	(110)	42.9	32.5	56.6	31.3	35.1	31.7	38.9
18	4.38E+06	(52)	4.81E+06	(57)	43.1	28.9	63.9	31.4	35.4	32.0	39.2
9	1.07E+07	(113)	1.10E+07	(116)	46.0	35.2	59.9	19.4	36.1	32.7	39.9
5	1.23E+07	(65)	1.21E+07	(64)	47.9	33.3	68.8	14.8	36.6	33.2	40.3
4	7.59E+06	(45)	6.24E+06	(37)	57.3	36.3	91.0	7.9	37.0	33.6	40.8
10	1.82E+07	(96)	1.35E+07	(71)	63.7	46.3	87.9	0.5	38.1	34.6	41.9
POOL	8.45E+06	(1459)	1.05E+07	(1809)				0.5	38.1	34.6	41.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 469.0, 29.6

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 38.1, 36.3 -- 40.0 (-1.8 +1.9)
95% CONF. INTERVAL(Ma): 34.6 -- 41.9 (-3.5 +3.8)
REDUCED CHI^2, DEGREES OF FREEDOM: 1.9950, 20
CHI^2 PROBABILITY: 0.5%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 37.9, 35.7 -- 40.2 (-2.2 +2.3)
95% CONF. INTERVAL(Ma): 33.8 -- 42.6 (-4.2 +4.7)
AGE DISPERSION (%): 15.3

CHI^2 AGE WITH 68% CONF. INTERVAL (Ma): 37.0, 35.2 -- 38.9 (-1.8 +1.9)
95% CONF. INTERVAL (Ma): 33.6 -- 40.8 (-3.4 +3.8)
NUMBER AND PERCENTAGE OF GRAINS: 20, 95%

APPENDIX D:

Binomial Peakfitting Data

BinomFit for Windows ver.1.2
[02/18/2014 12:02]   Main results
WB13-06a, U53Z-19 - 23-28 January 2014
File: C:\Users\Senterra\Desktop\FT Folders\Kate\Unknowns\WB1306A.ftz

FIT OPTION: Best-fit peaks using the binomial model of Galbraith and Green

PARAMETERS FOR BEST-FIT PEAKS
*   Standard error for peak age includes group error
*   Peak width is for PD plot assuming a kernel factor = 0.60

#.	Peak,Ma	68%CI	95%CI	W(Z)	Frac,%	SE,%	Count
1.	28.1	-1.6 ...+1.7	-3.1 ...+3.5	0.18	42.7	11.1	12.8
2.	41.2	-2.0 ...+2.1	-3.8 ...+4.2	0.16	57.3	11.1	17.2

Log-likelihood for best fit: -113.888
Chi-squared value for best fit: 30.666
Reduced chi-squared value: 1.136
Probability for F test: 0%
Degrees of freedom for fit: 27
Condition number for covar matrix: 9.58
Number of iterations: 8

BinomFit for Windows ver.1.2
[05/06/2014 11:13]   Main results
WB13-10a, U53Z-15 - 4 November 2013, 14 January 2014
File: C:\Users\Senterra\Desktop\FT Folders\Kate\Unknowns\WB1310a.ftz

FIT OPTION: Best-fit peaks using the binomial model of Galbraith and Green

PARAMETERS FOR BEST-FIT PEAKS
*   Standard error for peak age includes group error
*   Peak width is for PD plot assuming a kernel factor = 0.60

#.	Peak,Ma	68%CI	95%CI	W(Z)	Frac,%	SE,%	Count
1.	35.2	-1.6 ...+1.6	-3.0 ...+3.3	0.19	90.3	5.9	27.1
2.	59.0	-5.3 ...+5.9	-10.0 ...+12.0	0.16	9.7	5.9	2.9

Log-likelihood for best fit: -103.495
Chi-squared value for best fit: 32.028
Reduced chi-squared value: 1.186
Probability for F test: 0%
Degrees of freedom for fit: 27
Condition number for covar matrix: 7.69
Number of iterations: 21

BinomFit for Windows ver.1.2
[05/06/2014 11:19]   Main results
WB13-12a, U53Z-11 - 12 January 2014
File: C:\Users\Senterra\Desktop\FT Folders\Kate\Unknowns\WB1312A.ftz

FIT OPTION: Best-fit peaks using the binomial model of Galbraith and Green

PARAMETERS FOR BEST-FIT PEAKS
*   Standard error for peak age includes group error
*   Peak width is for PD plot assuming a kernel factor = 0.60

#.	Peak,Ma	68%CI	95%CI	W(Z)	Frac,%	SE,%	Count
1.	29.3	-2.7 ...+3.0	-5.1 ...+6.2	0.22	37.5	17.7	11.2
2.	42.7	-2.9 ...+3.1	-5.5 ...+6.2	0.22	62.5	17.7	18.8

Log-likelihood for best fit: -101.400
Chi-squared value for best fit: 31.281
Reduced chi-squared value: 1.159
Probability for F test: 0%
Degrees of freedom for fit: 27
Condition number for covar matrix: 14.92
Number of iterations: 17

BinomFit for Windows ver.1.2
[05/06/2014 11:34]   Main results
WB13-14a, U53Z-09 - 14 Nov 2013, 12 January 2014
File: C:\Users\Senterra\Desktop\FT Folders\Kate\Unknowns\WB1314A.ftz

FIT OPTION: Best-fit peaks using the binomial model of Galbraith and Green

PARAMETERS FOR BEST-FIT PEAKS
*   Standard error for peak age includes group error
*   Peak width is for PD plot assuming a kernel factor = 0.60

#.	Peak,Ma	68%CI	95%CI	W(Z)	Frac,%	SE,%	Count
1.	27.0	-2.5 ...+2.8	-4.7 ...+5.7	0.21	37.4	17.7	11.2
2.	39.9	-2.8 ...+3.0	-5.3 ...+6.2	0.22	62.6	17.7	18.8

Log-likelihood for best fit: -103.463
Chi-squared value for best fit: 30.652
Reduced chi-squared value: 1.135
Probability for F test: 0%
Degrees of freedom for fit: 27
Condition number for covar matrix: 15.38
Number of iterations: 37

BinomFit for Windows ver.1.2
[05/06/2014 11:28]   Main results
WB13-16a, U53Z-05 - 6-8 January 2014
File: C:\Users\Senterra\Desktop\FT Folders\Kate\Unknowns\WB1316A.FTZ

FIT OPTION: Best-fit peaks using the binomial model of Galbraith and Green

PARAMETERS FOR BEST-FIT PEAKS
* Standard error for peak age includes group error
* Peak width is for PD plot assuming a kernel factor = 0.60

#.	Peak,Ma	68%CI	95%CI	W(Z)	Frac,%	SE,%	Count
1.	35.3	-2.2 ...+2.3	-4.1 ...+4.7	0.20	78.1	18.7	23.4
2.	49.7	-7.2 ...+8.4	-13.1 ...+17.7	0.20	21.9	18.7	6.6

Log-likelihood for best fit: -102.051
Chi-squared value for best fit: 29.128
Reduced chi-squared value: 1.079
Probability for F test: 0%
Degrees of freedom for fit: 27
Condition number for covar matrix: 32.88
Number of iterations: 18

BinomFit for Windows ver.1.2
[05/06/2014 11:30]   Main results
WB13-17b, U53Z-02 - 30 January 2014
File: C:\Users\Senterra\Desktop\FT Folders\Kate\Unknowns\WB1317B.ftz

FIT OPTION: Best-fit peaks using the binomial model of Galbraith and Green

PARAMETERS FOR BEST-FIT PEAKS
* Standard error for peak age includes group error
* Peak width is for PD plot assuming a kernel factor = 0.60

#.	Peak,Ma	68%CI	95%CI	W(Z)	Frac,%	SE,%	Count
1.	30.4	-3.2 ...+3.6	-5.9 ...+7.4	0.20	34.1	18.6	7.2
2.	42.2	-2.7 ...+2.9	-5.2 ...+5.9	0.18	65.9	18.6	13.8

Log-likelihood for best fit: -74.400
Chi-squared value for best fit: 21.242
Reduced chi-squared value: 1.180
Probability for F test: 0%
Degrees of freedom for fit: 18
Condition number for covar matrix: 16.86
Number of iterations: 10