



Neotectonics of a Complex Plate Boundary Zone: Indentation, Rotation, and Escape in Alaska

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Convergence of thick crust of the Yakutat block with the southern margin of Alaska is widely recognized as a dominant influence on the tectonics of Alaska since at least late Miocene time. It is less clear how this convergence relates to the distribution, type, and orientation of geologic structures, and to the boundaries between the tectonic provinces that they define. We propose that convergence of Yakutat block includes two distinct components that influence deformation and topography in different ways:

1) The crust of the exposed, southern Yakutat block is too thick to subduct, which has caused the collisional St. Elias orogen. Detachment of the upper part of the mafic basement allows delamination and sinking of the remaining mafic crust and lithospheric mantle. The collisional orogen drives rigid counterclockwise rotation of the southern Alaska block south of the arcuate, right-lateral Denali fault. The western boundary of this block is a zone of distributed contraction in the western Alaska Range and Cook Inlet. *(continued)*

AGS Luncheon

Date & Time: May 16th, 11:30 am – 1:00 pm

Program: Neotectonics of a Complex Plate Boundary Zone: Indentation, Rotation, and Escape in Alaska

Speaker(s): Wes Wallace, UAF

Place: BP Energy Center

Reservations: Make your reservation before noon Tuesday, May 14th, 2013.

Cost:	Seminar only, no meal:	Free
	Reserve a box lunch:	\$15
	Reserve a hot lunch:	\$20
	Lunch with no reservation:	
	On an "as-available" basis only	

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View to the northwest of Denali (20,320 ft, 6,194 m) and Mt. Foraker (17,400 ft, 5,304 m), the high points of a high massif in the central Alaska Range. The incised plateau in the foreground is part of the Talkeetna Mountains, a topographic high that spans the projected position of the fore-arc basin. The Denali massif, the Talkeetna Mountains, and a gap in the magmatic arc correspond with gently dipping subducted Yakutat crust.

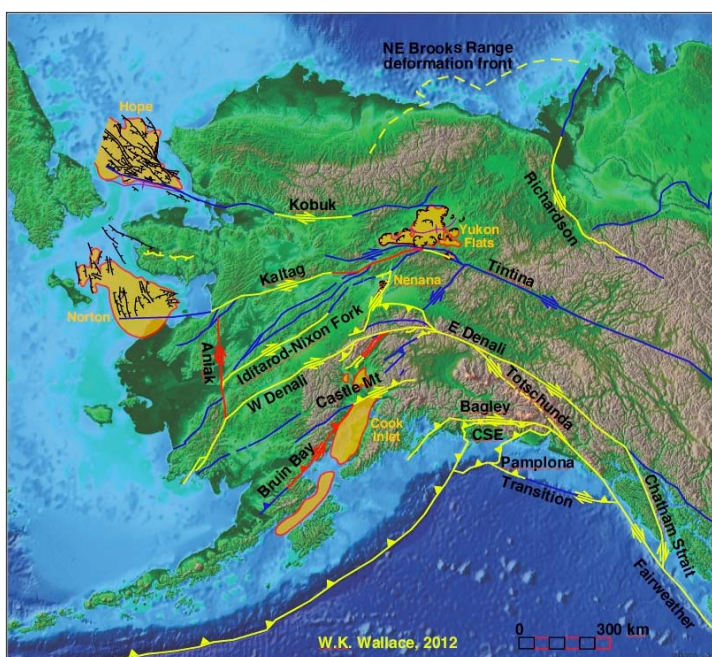


View to the northeast of the two highest peaks of the collisional St. Elias orogeny, Mt. St. Elias (right, 18,008 ft, 5,489 m) and Mt. Logan (left, 19,551 ft, 5,959 m). Yahtse Glacier (foreground) terminates at sea level just out of the picture to the right. The tremendous topographic relief of Mt. St. Elias is apparent because it is only 20 km from a marine shoreline.

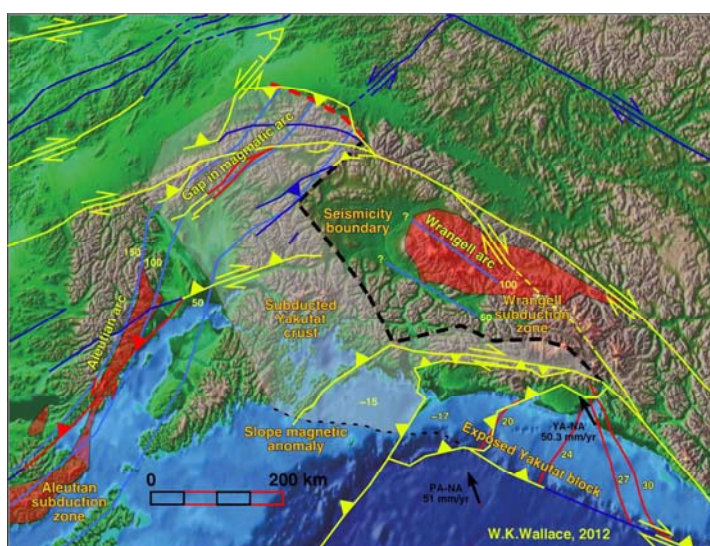
2) The northern part of the Yakutat block is thin enough to subduct but thick and buoyant enough to cause localized flat-slab subduction orthogonal to rotation of the southern Alaska block. Consequences include the gently antiformal Talkeetna Mountains that span the forearc basin, a gap in the magmatic arc, and a basement-involved fold-and-thrust belt in the northern Alaska Range. An arcuate oroclinal hinge from southern Alaska to the northeastern Brooks Range reflects indentation since at least Paleocene time. Traction above the subducted Yakutat block along the southern part of this hinge drives current indentation. North of the subducted Yakutat block, indentation is reflected by left-lateral block rotation that accommodates shortening between the Denali and Tintina faults and by contraction farther north along the northern edge of the arcuate northeastern Brooks Range.

Western Alaska accommodates both northward indentation and westward convergence of the southern Alaska block by right-lateral block rotation and tectonic escape related to local left-lateral faults. Farther west, slow clockwise rigid rotation of the extensive Bering block accommodates escape and is separated from stable northwestern Alaska by a zone of extension.

These tectonic provinces are defined by mapped structures and by the distribution and focal mechanisms of earthquakes. Structures are generally consistent with stress orientations determined from earthquakes, but local discrepancies between observed structures and those predicted from the stress determinations suggest that reactivation of older structures is important.



Interpretive map of Neogene faults and basins of mainland Alaska and northwestern Canada. Fault colors indicate knowledge of Neogene activity: Yellow: known; red: suspect; blue: unknown, but active some time between Late Cretaceous and present. Orange indicates Eocene and younger basins. CSE: Chugach-St. Elias. Based on Neotectonic Map of Alaska (Plafker et al., 1994) and other published sources.



Relation of Yakutat block collision and subduction to faults and magmatic arcs in south-central Alaska. Contours: light blue: depth to Wadati-Benioff zones; red: thickness of Yakutat crust (from Worthington et al., 2012, JGR).

Abstract from: Wallace, W.K., and Ruppert, N., 2012, Young tectonics of a complex plate boundary zone: Indentation, rotation, and escape in Alaska: American Geophysical Union fall meeting, San Francisco, CA, Abstract T14A-08, 3 December, 2012.

About the Speaker:

Wes Wallace has worked on the structural geology and tectonics of Alaska since 1975, when he began his Ph.D. project on the Border Ranges fault east of the Trans-Alaska Pipeline. He worked with ARCO in Anchorage (1981-1985) on the regional tectonic framework and evolution of Alaska, with emphasis on southwestern Alaska and the Brooks Range. In 1985, he moved to the University of Alaska Fairbanks, where his focus has been on fold-and-thrust structures, mainly in the Brooks Range. In recent years, he and his students have worked on the young tectonics of the northern Alaska Range and the Fairbanks area. In this talk, Wes summarizes an interpretation of the young tectonic framework of Alaska that he has developed over the years that he has worked throughout Alaska and taught a graduate class on the geologic evolution of Alaska.

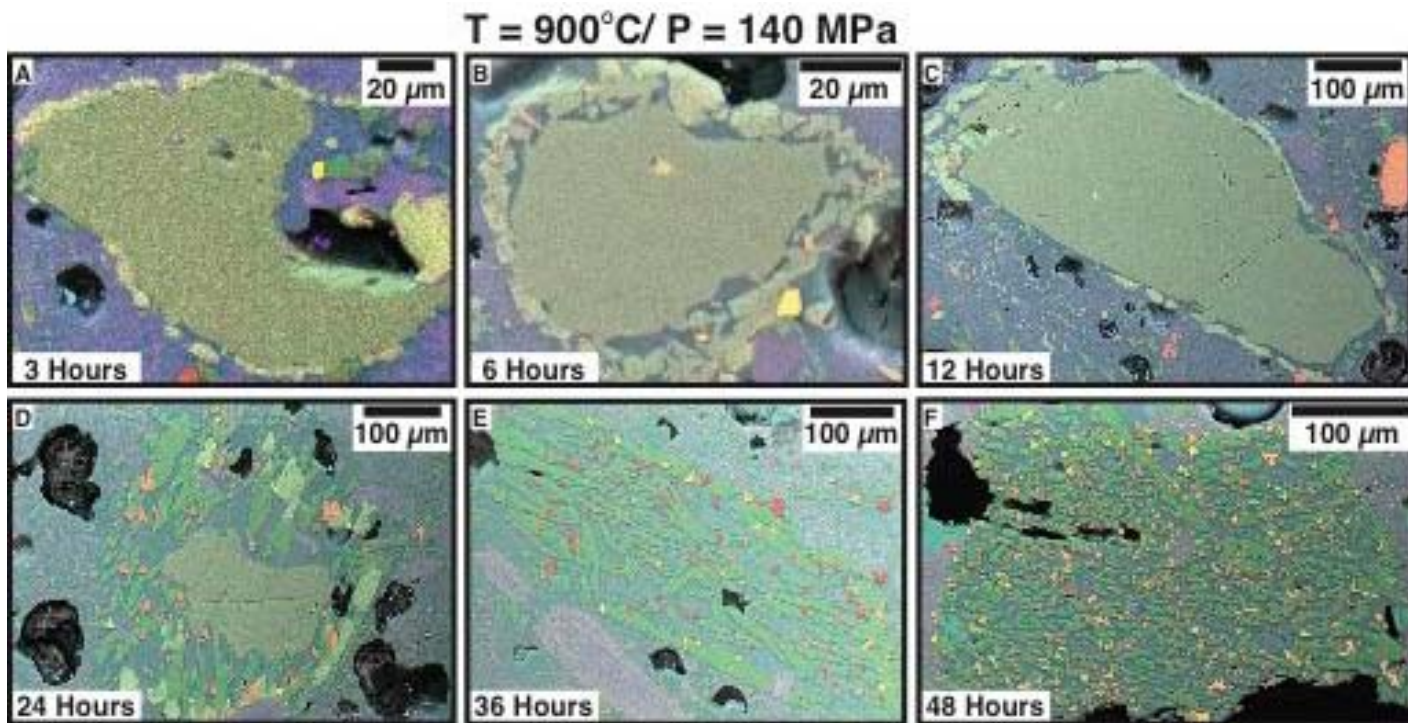
Scholarship Update

Experimental insights into the formation of amphibole reaction rims: Texture, mineralogy, and processes of formation (Partial Funding: Alaska Geological Society Scholarship)

Sarah Henton, University of Alaska Fairbanks

Amphibole is an important mineral present in many calc-alkaline volcanic deposits. A hydrous phase, volcanic amphibole is only stable at pressures greater than ~100 MPa (approx. 4 km) and in melts containing at least 4 wt % H₂O. When removed from their thermal and barometric stability field, amphiboles decompose to form aggregate rims of anhydrous minerals. Reaction rim thicknesses have been used to estimate timescales and rates of magma ascent, an important parameter in determining eruptive style. However, the process of reaction rim formation is complex; numerous magmatic properties exert a control on the reaction process (e.g. magma compositions and viscosities) and multiple forcing factors may be responsible for their formation (e.g. heating, decompression, or changes in magma chemistry). Due to a lack of experimental work, amphibole reaction rims are a poorly understood and commonly misused source of information of magmatic processes.

This experimental study at the University of Alaska Fairbanks, funded in part through the generosity of the Alaska Geological Society, presents one of the first in-depth, systematic, and quantitative investigations of reaction rim textures and mineralogy. During a series of experiments, amphiboles were subjected to differing degrees of thermal or barometric instability, over different time scales, ranging from 3 – 144 hours. The resulting reaction rims were analyzed using a variety of analytical imaging and X-ray mapping techniques. The results of this study, which are currently being prepared for publication, show that a range of different processes can contribute to the formation of amphibole reaction rims. A key result is that the mineralogical and textural features of many experimental heating-induced amphibole reaction rims are indistinguishable from natural reaction rims attributed by past studies to decompression (and subsequently used to infer magma ascent rates).



Composite X-Ray maps of experimental amphibole reaction rims. Reactions depicted were all formed at a temperature of 900°C and at a pressure of 140 MPa. Successive images reflect increasing experiment durations: A) 3 hours; B) 6 hours; C) 12 hours; D) 24 hours; E) 36 hours; F) 48 hours. Different colors depict different minerals. Exact shading varies between images but in general: blue = glass; purple = plagioclase; red = magnetite; yellow = ilmenite; 'olive' green = amphibole; green = orthopyroxene; yellow/green = clinopyroxene. Images show how amphibole reaction rims increase in width and also in textural and mineralogical complexity as heating duration is increased.

ALASKA FOSSIL OF THE MONTH

SAPELNIKOVIELLA SANTUCCII – A NEW ALASKAN SILURIAN BRACHIOPOD GENUS AND SPECIES IS BORN

Robert B. Blodgett (Consulting Geologist, Anchorage, Alaska)

This month's selection for the Alaska Fossil of the Month is a newly described brachiopod *Sapelnikoviella santuccii* Blodgett, Baranov, Boucot, and Rohr, 2013 (see Figure 1) from the upper Silurian Willoughby Limestone on Drake Island in Glacier Bay, Southeast Alaska (see Blodgett et al., 2013a for the formal taxonomic naming paper).

The genus name is in honor of Vadim P. Sapelnikov (1930-2004) of Ekaterinburg, Russia, a leading scholar of Ordovician-Devonian brachiopods, and an expert in particular on the Suborder Pentameridina to which the new genus belongs. The species name is in honor of Vincent L. Santucci, geologist/paleontologist with the US National Park Service, in recognition of his strong support for paleontological work being conducted on National Park Service lands and for being the 'father' of National Fossil Day. National Fossil Day is a partnership to promote the scientific and educational values of fossils. Over 230 partner museums, scientific and educational organizations, fossil sites, agencies and amateur groups collectively host fossil events and activities in all 50 states, making National Fossil Day a nation-wide celebration.

The fossil locality (11RB16) where the new fossil was found is situated on the southwest side of Drake Island (Fig. 2) in Glacier Bay. Both sides of Glacier Bay consist primarily of spectacular exposures of Paleozoic age formations (i.e., Willoughby Limestone, Tidal Formation, Pyramid Peak Limestone, etc.) (see Fig. 3 for generalized columnar section of the rock units exposed here). The basic stratigraphic framework geology of the region was provided by Rossman (1963) and Seitz (1959). Documenting such new and biostratigraphically significant fossils is important to Alaskan geological studies, as very few Paleozoic age fossils have been described from the State, despite over 100+ years of active field work. Documenting these fossils is obviously most critical in providing fossil age control, but also provide invaluable information on the ecologic setting in which the host strata were deposited, and also in providing paleobiogeographic signals needed in our terrane-bound rocks to determinate original sites of origin and possible wandering paths prior to accretion.

I was invited by the staff at Glacier Bay National Park & Preserve to undertake a paleontological assessment of the fossil resources throughout the entire areal extent of the park, the results of which are now partially published (Blodgett et al., 2010a, 2012), and a large Excel spreadsheet was also provided to the park showing all previously known and reported fossil occurrences therein. This work in part overlapped with collaborative studies with other colleagues on the fossil fauna from Glacier Bay (Rohr and Blodgett, 2003; Rohr et al., 2003) and also to the south on northeast Chichagof Island where similar faunas and facies are found: Kříž et al., 2013; Boucot et al., 2012; Rohr et al., 2011). One emerging facet of the study is the overwhelming faunal evidence which indicates that the Alexander terrane faunas of Silurian and Devonian age are most similar to those found in Northeast Asia (Kolyma region), suggesting a rift origin of the Alexander terrane ultimately from that region (Blodgett et al., 2010b, 2013b). Overall lithofacies similarities and some new emerging detrital zircon ages are also concordant with that view.

Sapelnikoviella santuccii occurs in a small-pocket like accumulation of brachiopods (predominantly this species and the genus *Septatrypa*), along with high-spined murchisoniid gastropods (see Fig. 4) which occur within massive microbial reefs that appear to have occurred on the seaward edge of the Willoughby Limestone platform edge (see Fig. 5 for view of locality). An new interesting aspect of our regional study in Glacier Bay is that the classical view of Rossman (1963) of the deeper-water Tidal Formation (in places bearing graptolites) succeeding the Willoughby Limestone is now suspect. Our work indicates that these two units rather represent facies equivalents of one another, with the upper Silurian Willoughby Limestone occurring primarily on the west side of Glacier Bay (with the exception of the exposures at Gloomy Knob), and the age equivalent Tidal Formation restricted areally to exposures to the east. In Tidal Inlet, one can even observe large olistoliths blocks seeming derived from the Willoughby Limestone reef edge (Rohr et al., 2013). The overall Silurian facies pattern expressed in Glacier Bay continues to the southeast onto northeast part of Chichagof Island, where the Willoughby Limestone is represented the Kennel Creek Limestone (shallow-water carbonate platform) and the Tidal Formation is represented by the lower part of the Cedar Cove Formation. One amazing fact about the Silurian age succession in Glacier Bay is that in overall thickness it is one of the thickest succession of rocks of such age in North America, and in fact, in much of the world.

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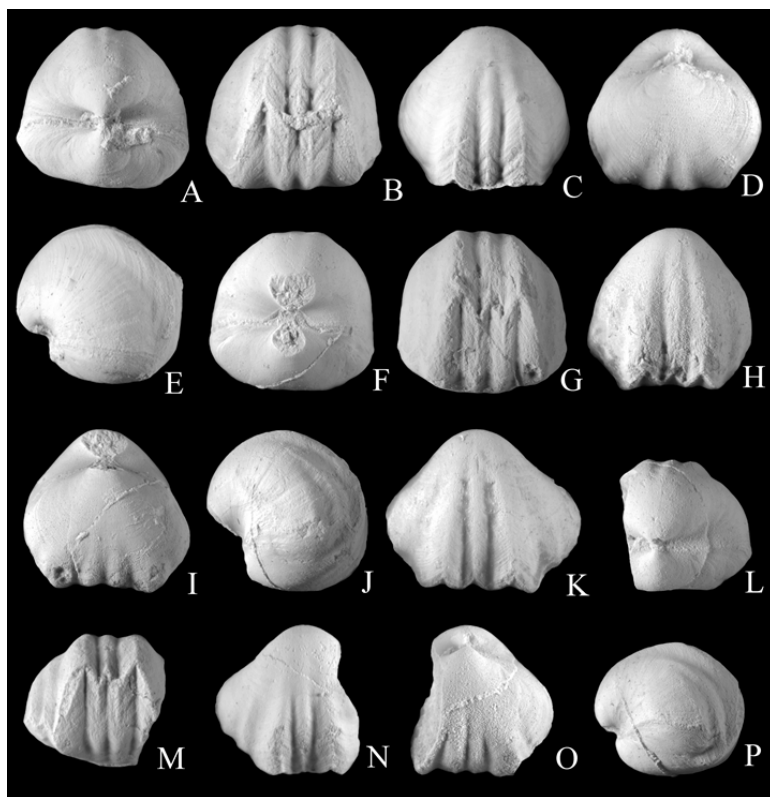


Figure 1. *Sapelnikoviella santucci* Blodgett et al., 2013a, Willoughby Limestone (Ludlow, or upper Silurian), locality 11RB16, Drake Island, Glacier Bay, Southeast Alaska. Four specimens are shown on this plate.

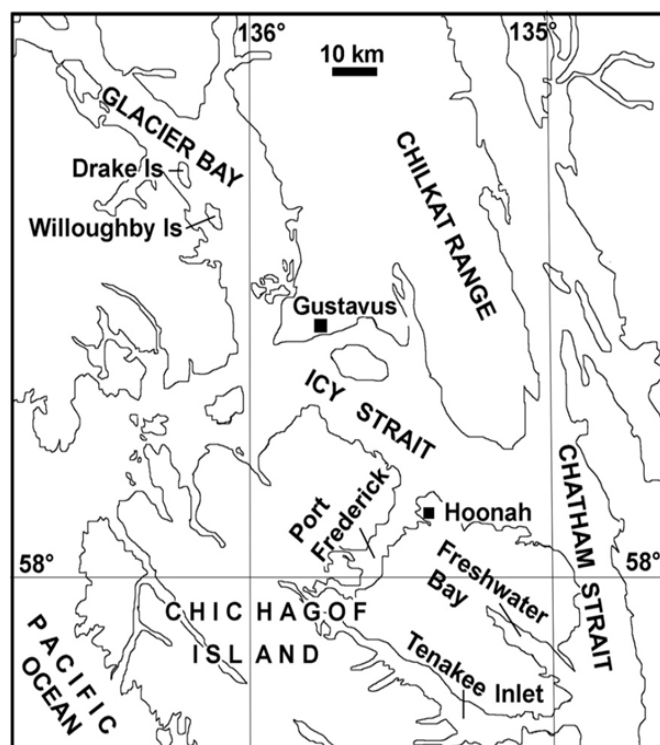


Figure 2. Index map of the northern part of Southeast Alaska showing the location of some of the geographic features referred to in the text (Drake Island, Willoughby Island, Chichagof Island).

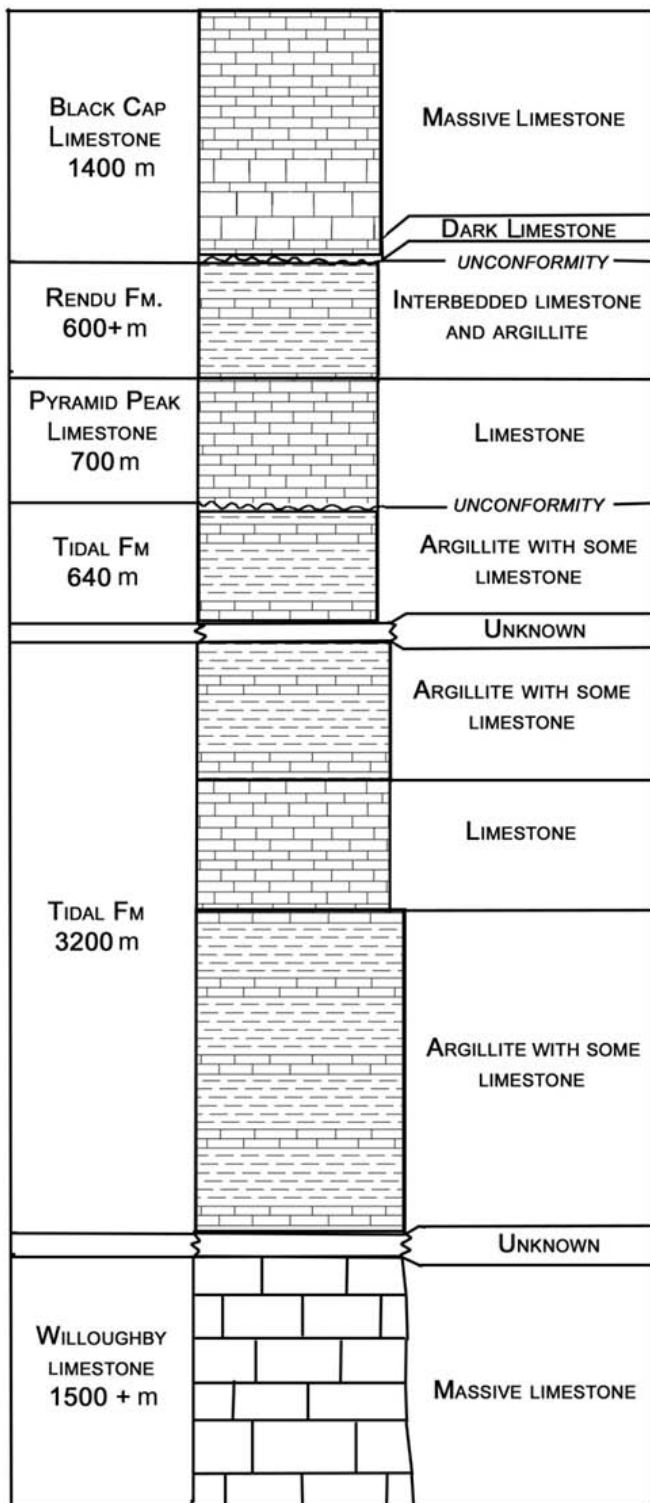


Figure 3. Generalized columnar section of Paleozoic rocks in Glacier Bay (modified from Rossman 1963, fig. 2).

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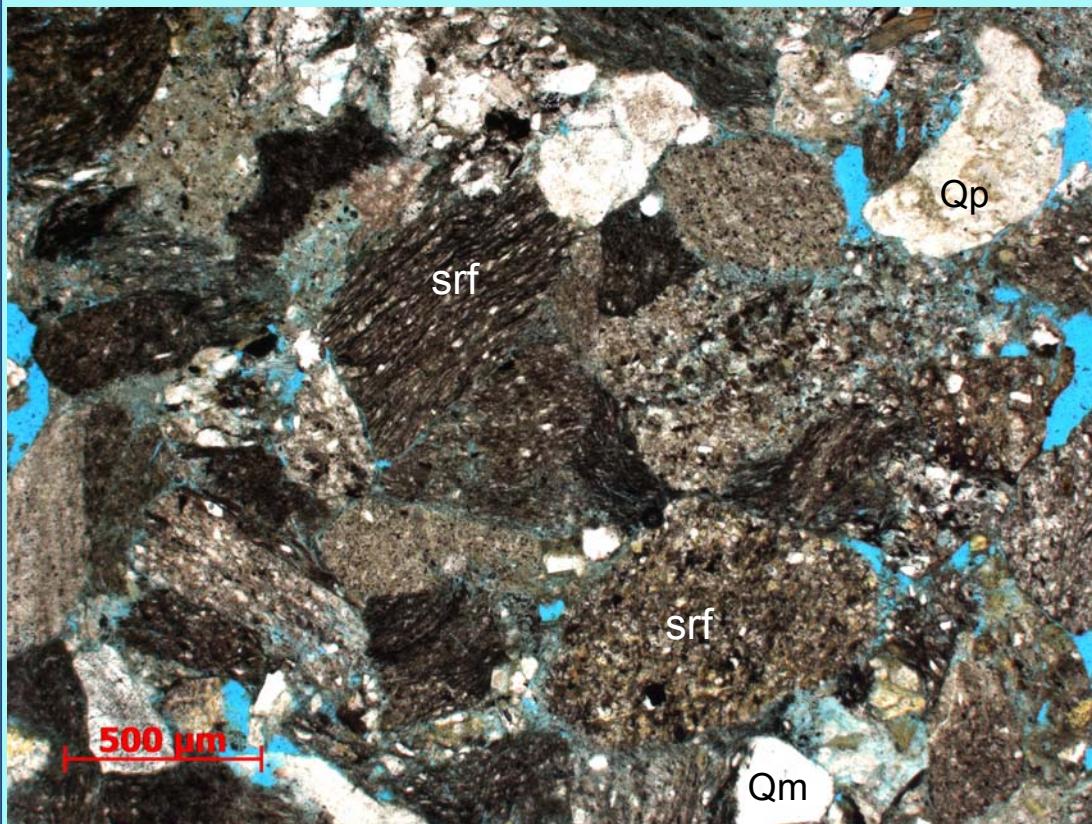
Figure 4. Photograph of pocket-like accumulation of brachiopods (*Septatrypa*, *Sapelnikoviella santucci*) and high-spired murchisoniid gastropods at locality 11RB16 on the southwest shore of Drake Island. Note presence of spiralia in *Septatrypa*. Coin 24 mm. diameter.



Figure 5. View of fossil locality 11RB16 in microbial limestone builds in the Willoughby Limestone on the west side of Drake Island, Glacier Bay, Southeast Alaska. Vincent L. Santucci (NPS) standing near fossil site. View to the NNW.



Figure 6. Large limestone olistolith block (white colored) derived from platform edge of Willoughby Limestone and deposited in the coeval basinal equivalent beds of the Tidal Formation on the south side of Tidal Inlet. Vincent L. Santucci (left) and David M. Rohr (right).



Photomicrograph of Beluga sandstone consisting largely of argillaceous sedimentary rock fragments (srf) and occasional monocrystalline (Qm) and polycrystalline (Qp) quartz grains. A measured porosity of 27.8% suggests that microporosity contributes significantly to the overall pore system. Upon deep burial and compaction, this rock would begin to resemble a sandy-silty shale; in essence a "diagenetic" shale created by the compaction-induced ductile grain deformation of a sandstone. Beluga sandstones comprise important gas reservoirs in Cook Inlet. Sample is from a measured section at Fritz Creek on the northwest shore of Kachemak Bay; collected by Jake Mongrain. Send me a photo of your pet rock at:

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Earl E. Brabb—USGS Geologist

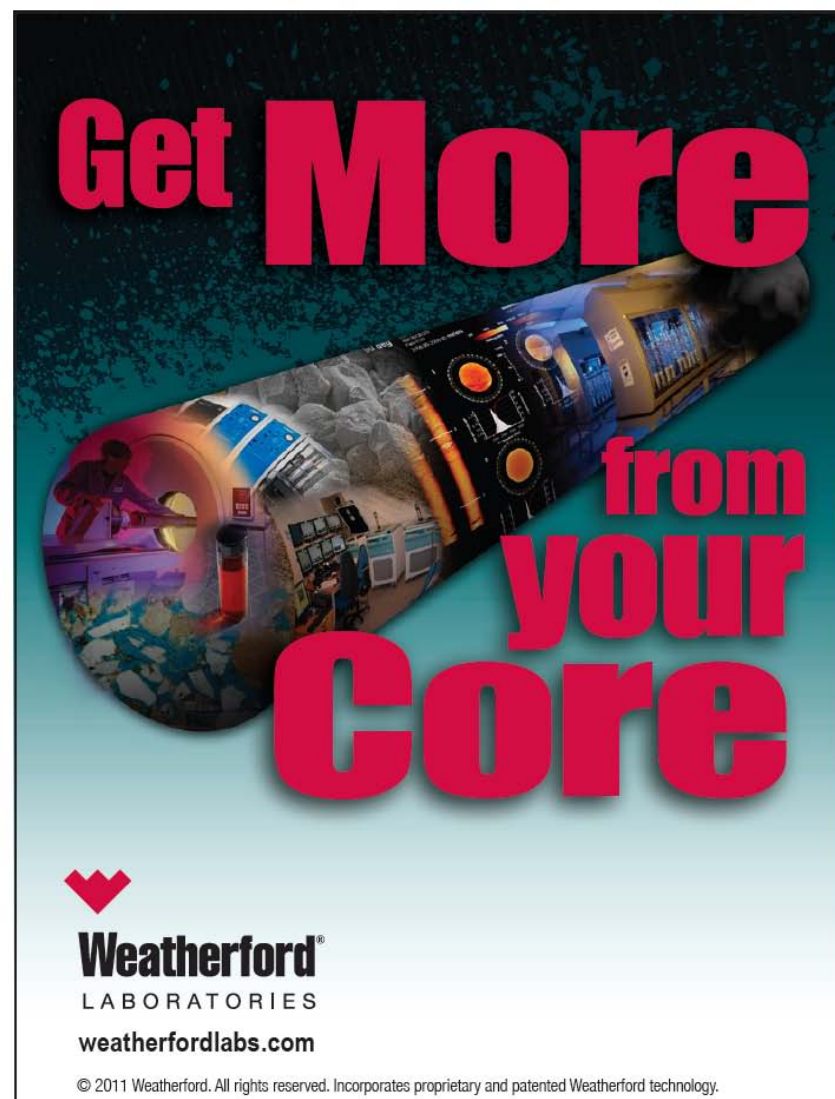
Earl E. Brabb, a geologist and internationally noted expert on the hazards of landslides and earthquakes, died Sept. 14, 2012 after a brief illness. He was 83.

Earl was born in Detroit, majored in geology at Dartmouth College and received his master's degree at the University of Michigan. He earned his doctorate at Stanford, where his work mapping Santa Cruz mountain geology and biostratigraphy set the stage for his entire career.

Earl was a leading scientist at the U.S. Geological Survey in Menlo Park for 52 years. Early in his career he spent several years in the wilderness of eastern Alaska mapping the Charley River and Black River quadrangles. During his Alaska period, Earl collected fossils of extinct animals, including four newly discovered species that were later named for him.

Later in his career at the USGS, Earl traveled throughout the United States to lead a nationwide assessment of landslide hazards and damage. He also founded the International Landslide Research Group, whose members study the impact of landslides in more than 100 nations.

During his career, he received Meritorious and Distinguished awards from the Department of the Interior, and a medal from the European Geophysical Society for his exceptional contributions to natural hazards research.

The graphic features a large, stylized red text overlay that reads "Get More from your Core". The background is a dark, textured blue-green. A central image shows a cross-section of a core sample, revealing internal structures and data. Below the main text, the Weatherford Laboratories logo is displayed, consisting of a red stylized 'W' above the word "Weatherford" in bold, with "LABORATORIES" in smaller text below it. The website "weatherfordlabs.com" is listed at the bottom. A small copyright notice at the very bottom states: "© 2011 Weatherford. All rights reserved. Incorporates proprietary and patented Weatherford technology."

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Contact membership coordinator Ken Helmold with changes or updates (e-mail: ken.helmold@alaska.gov; phone: 907-269-8673)

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AGS Denali Field Trip 2013 – June 21-23

The Denali National Park & Preserve area provides one of the few opportunities in Alaska for road-side access to good rock outcrops. The rocks and surficial deposits exposed in the Denali area span from the early Paleozoic to the Quaternary. It is a structurally complex area that records evidence of numerous episodes of deformation and metamorphism in the Mesozoic, Tertiary, and present day. The region is the site of active faulting along one of the largest intra-continental fault systems, the Denali Fault system, which was the locus of a 7.9 M earthquake as recent as 2002. Rock units visited will include poly-deformed Devonian to Mississippian schist (that record rifting along the North American margin); Triassic greenstone diabase, and pillow basalt (another rifting episode); Triassic deep-water shales; Late Jurassic to Early Cretaceous marine flysch (formed during accretion of most of southern Alaska); Devonian limestone olistostromal blocks; Late Cretaceous fluvial conglomerate and sandstone (containing dinosaur tracks); early Tertiary fluvial and lacustrine conglomerate, sandstone, and shale (that record the uplift of the Alaska Range); and numerous glacial deposits formed during the last ice-age.

June 21 – Leave Anchorage 5:30 pm

The field trip will start from Anchorage at 5:30 pm on June 21. We will drive directly to the McKinley Park area and stay at the Denali Education Center (estimate 5 hours driving time).

June 22 – Geologic tour of Denali National Park & Preserve road

On the morning of June 22 breakfast will be provided at the Denali Education Center, and a sack lunch will be provided. We will depart at 8:30 am for a geologic tour of the Denali National Park & Preserve road as far as the Eielson Visitor Center (estimate 9 hours driving time). Dinner will be on your own.

June 23 – Geologic tour of the Parks Highway from Healy to Cantwell

On Sunday June 23, we will depart the Denali Education Center at 8:00 and stop at a local restaurant for breakfast. We will then drive to Healy where we will start a geologic tour of the Parks Highway between Healy and Cantwell (stopping for lunch along the way). After the end of the tour we will drive back to Anchorage.

Trip Leaders: **Chad Hults**; US Geological Survey and **Denny Capps**; Denali Park Geologist, NPS

Due to vehicle restrictions on the Denali Park Road, only one 15 passenger van can be used, so the field trip is limited to the first 12 people that sign up.

Sign up for this trip on the AGS website: http://www.alaskageology.org/fieldtrips_denali_June2013.htm



View of Mt. McKinley from Sable Pass on the Denali National Park & Preserve road



Suntrana area coal Tipple near the Usibelli Coal Mine. This is the location of the Tertiary Usibelli Group type section

Alaska Geological Society

May 2013 Election Ballot for Officers, Board Members, AAPG Delegate, and Proposed Amendment



AGS Officers

☐ *President Elect* - Keith Torrance

(President for 2014-2015)

☐ *Vice President* - Monte Mabry

☐ *Secretary* - Eric Cannon

☐ *Treasurer* - Al Hunter

Write-in Candidate(s)

☐ _____

Position and Name

2013-2015 Board Members (vote for three)

☐ *Board Member* - Tom Morahan

☐ *Board Member* - Jim Brown

☐ *Board Member* - Richard Lease

Write-in Candidate(s)

☐ _____

Name

2013-2015 AAPG Delegate

(only Active AAPG members may vote for the AAPG delegate)

☐ *AAPG Delegate* - Marwan Wartes

Write-in Candidate

☐ _____

Name

Proposed amendment to the bylaws in ***bold italics & underlined***:

Old: Article X. Fiscal Management

SECTION 6. *Expenditures*. All expenditures over \$500 for any one item or purpose must be approved by a majority of the Board present at any regular or special meeting of the Board of Directors. All expenditures over \$5000 for any one item or purpose must be approved by a majority of the members present at any regular or special meeting of the Society.

SECTION 7. *Contracts*. The Board of Directors may authorize any officer or officers, agent or agents of the Society, in addition to officers expressly authorized by these Bylaws, to enter into any contract or execute and deliver any instrument of and on behalf of the Society, and such authority may be general or confined to specific purposes.

SECTION 8. *Checks, drafts*. All checks, drafts, or orders for the payment of money, notes, or other evidences of indebtedness issued in the name of the Society, shall be signed by two Officers of the Society, and in a manner determined by resolution of the Board of Directors.

New: Article X. Fiscal Management

SECTION 6. *Expenditures*. All expenditures over ***\$1000*** for any one item or purpose must be approved by a majority of the Board present at any regular or special meeting of the Board of Directors. All expenditures over \$5000 for any one item or purpose must be approved by a majority of the members present at any regular or special meeting of the Society.

SECTION 7. *Contracts*. The Board of Directors may authorize any officer or officers, agent or agents of the Society, in addition to officers expressly authorized by these Bylaws, to enter into any contract or execute and deliver any instrument of and on behalf of the Society, and such authority may be general or confined to specific purposes.

SECTION 8. *Checks, drafts*. All checks, drafts, or orders for the payment of money, notes, or other evidences of indebtedness issued in the name of the Society, ***if under \$500, can be signed by the Treasurer and all board members notified with the date and the amount of the transaction by email at the time the transaction was completed. All other checks, greater than \$500 shall be signed by two Officers of the Society,*** and in a manner determined by resolution of the Board of Directors.

There shall be one debit card, retained by the Treasurer and available to the President, Vice President and Secretary with a limit of \$300 for making deposits, obtaining petty cash to make change at meetings and for paying fees and other charges requiring electronic payment.

Shall the AGS amend the bylaws of the organization with the changes approved by a vote of the Alaska Geological Society Board of Directors?

☐ *Approve*

☐ *Disapprove*

Please mail your ballot by May 18th to:

Alaska Geological Society

PO Box 101288

Anchorage, AK 99510

Ballots will also be available at the
May 16th luncheon

2012 - 2013 Alaska Geological Society Board

		Phone	e-mail	Workplace
President	Art Banet		banetak at gci.net	BLM emeritus
Past-President	Ken Helmold	269-8673	Ken.helmold at alaska.gov	AK DOG
President-Elect	Matt Frankforter	777-8376	Mfrankforter at hilcorp.com	Hilcorp Alaska, LLC
Vice-President	Monte Mabry	564-4028	Monte.mabry at bp.com	BP
Treasurer	Al Hunter	777-8324	Paleoman at mac.com	
Secretary	Eric Cannon	344-6001	Eccannon at gmail.com	Golder Associate Inc.
Director 12-2014	Chad Hults	786-7417	Chults at usgs.gov	USGS
Director 12-2014	Trystan Herriott	451-5011	trystan.herriott at alaska.gov	DGGS
Director 12-2014	Kirk Sherwood	334-5337	Kirk.Sherwood at boem.gov	BOEM
Director 11-2013	Tom Homza	770-3701	Thomas.Homza at shell.com	Shell
Director 11-2013	Tom Morahan	230-1672	tmorahan at petroak.com	ConocoPhillips (PRA)
Director 11-2013	Jim Brown	276-2675	Jbrown at alaskapacific.edu	Alaska Pacific University

Committees and Delegates

		Phone	e-mail	Workplace
AAPG Delegate &	David Hite	258-9059	Hitelamb at alaska.net	Geological Consultant
Advertising	Keith Torrance	264-4506	Ktorrance at apcservicesllc.com	APC Services LLC
Com. Ed./Science Fair	Jana DaSilva Lage	677-7883	Jldasilva5 at hotmail.com	AeroMetric
Field Trips	Chad Hults	786-7417	Chults at usgs.gov	USGS
Bylaws	Sue Karl	786-7428	Skarl at usgs.gov	USGS
Memberships	Ken Helmold	269-8673	Ken.helmold at alaska.gov	AK DOG
Newsletter Editor	Ken Helmold	269-8673	Ken.helmold at alaska.gov	AK DOG
Publications	Peter Johnson	334-5329	Peter.Johnson at boem.gov	BOEM
Scholarship	Sue Karl	786-7428	Skarl at usgs.gov	USGS
Website	Jan Hazen		Jan at homestead-graphics.com	Consultant
Fundraising	Sunny Foster	269-8707	Sunny.Remmy at Alaska.gov	DNR / DOG

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