

The Brooks Range, Alaska: An Orogenic Belt with a Complex History

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The geology of the Brooks Range is complex and there are many unanswered questions. This presentation will touch on the history of ideas regarding the development of the Brooks Range orogen and discuss some newer and ongoing work in the metamorphic core of the range and Seward Peninsula.

My introduction to the Brooks Range orogen was a long working field trip in 1987 organized by ARCO geologists and led by Gil Mull. His encyclopedic knowledge of Brookian stratigraphy, structures and their fossil age constraints were the starting point for our attempts to untangle the complex relations in the southern part, or metamorphic core of the range. Gil led us through the allochthons of the western Brooks Range and showed us evidence for Brookian thrust faulting into the earliest Cretaceous, the age of the syn-tectonic deep marine Okpikruak

On this same trip, Gil was with us in the Cosmos Hills and environs, along the southern flank of the Brooks Range, as we chased the fault contacts that juxtaposed the mafic and ultramafic rocks of the highest Brooks Range allochthons onto the deepest metamorphic levels of the orogen. At that time, this fault system was thought to represent the "root zone" for allochthons in the northern Brooks Range, elegantly illustrated by Roeder and Mull (1978). Further work by many led to the interpretation of this fault system as post-thrusting, down-to-the south normal faults, helping explain the strip of mafic and ultramafic rocks along the south flank of the range and the significant thickness of marine clastic strata deposited southward into the Yukon-Koyukuk basin in the Aptian-Albian. More recently, the coeval North Slope clastic sequences have been discovered to come from Russia not the Brooks Range (Moore et al., 2015; Lease et al., 2022). Blueschist minerals in their heavy mineral suites (Till, 1992) are now hard to link to Brookian events and are mysterious in origin. We are free to mostly uplift the Brooks Range in the Cenozoic by large-wavelength folding and thrust faulting, compatible with existing and new low-T thermochron data sets. These structures clearly modify older geologic and structural features of the Brooks Range. (*continued on page 2*)

AGS Meeting

Date & Time:	Monday, October 30; Doors open 11:00 am, announcements 11:15 am, talk 11:30 am–12:30 pm			
Program:	The Brooks Range, Alaska: An orogenic belt with a complex history			
Speaker:	Elizabeth Miller, Department of Earth and Planetary Sciences, Stanford University, Stanford, CA			
Place:	Networking at BP Energy Center, Birch room. Virtual presentation via Google Meet.			
Reservations:	Reservations are not required			
Login:	For instructions on how to log in see AGS website: <u>http://www.alaskageology.org/events.html</u>			
How to Join:	Join with Google Meet: meet.google.com/kvf-kyvn-rvq			
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Structurally beneath the system of down-to-the south normal faults, lie rocks of the Schist Belt (Coldfoot terrane) and Central Belt (Hammond terrane) that together comprise the "metamorphic core" of the Brooks Range. Based on detrital zircon (DZ) dating in the Brooks and Seward Peninsula, rock packages spanning the Precambrian to upper Paleozoic are present in both. The Schist belt is distinguished by its penetrative deformational fabric and local relict blueschist facies minerals and extends along the southern flank of the range for 600 km with counterparts on the Seward Peninsula and possibly Wrangel Island, Russia, another 800 km away. It's a broad zone (km's to > 15 km) of deformation, characterized by an intense transposition/crenulation cleavage formed during flattening normal to foliation and N-S stretching, evolving to localized simple shear and brittle faulting along the southernmost flank of the range. Current exposure of Schist belt rocks and overlying fault systems/ Koyukuk Basin sediments is the result of folding and uplift during NS shortening in the Cenozoic, revealing parts of an extensional fault system not typically exposed in orogenic belts. Fluid-assisted metamorphic zircon overgrowth on detrital zircon populations in Schist belt rocks yield ~ 114 ± 5 Ma U-Pb ages from several separate localities (Hoiland et al., 2018). This remarkably long belt of high strain deformation is spatially and temporally linked to the northern margin of a magmatic belt developed across Arctic Russia and central Alaska between 120-90 Ma. The Schist belt fabrics (and equivalents on Seward Peninsula and Wrangel Island) are interpreted as extension-related and post-thrusting. New structural work and geologic mapping suggests that extension-related fabrics like those of the Schist belt may be developed to variable extent across the Central Belt as well, suggesting that a major post-thrusting extensional deformation and metamorphic event has shaped what is now the metamorphic core of the Brooks Range orogen.

We don't yet understand many aspects of the Brooks Range orogen, such as why the basal thrust of the Brooks Range fold-thrust belt dips consistently north instead of south (is it folded? Is it a normal fault system?), revealing the vast dome-shaped metamorphic core of the range. Because of the younger, likely extensional deformational and metamorphic overprint, we still know little about the structural relations of rock units in the Central and Schist Belts and the role they played in Brookian and older orogenesis

About the Speaker:

Dr. Elizbeth Miller is an Emeritus Professor in the Department of Earth and Planetary Sciences at Stanford University. Her research is focused around structural geology, regional geology and tectonics, and how rocks deform from the atomic to regional scale. Dr. Miller has published or contributed to hundreds of peer reviewed articles, and has received many awards for her technical excellence and contributions to teaching. She holds a M.A. and Ph.D. in geophysics from Rice University and B.A in geology from Franklin and Marshall College.

From the President's Desk:

I want to welcome everyone to the 2023-2024 season for AGS.

The new AGS Board held their first two meetings in person! The Board had a full quorum at the both meetings and was able to approve several key positions and conduct other business. The Alaska Geological Society now has all Board spots, including Executive positions, filled for the season. The Board also spent time discussing upcoming '23-'24 programs and AGS priorities. In addition all luncheon spreakers have been scheduled for this season.

AGS is committed to in person or face-to face interactions at all meetings. Board meetings at the Atwood and luncheons at the Energy Center will be in person events, even if speakers need to present remotely or select attendees feel they must call in.

As AGS President, I can wholly identify with the following quote from AAPG past president, Steven Goolsby. Steven nicely sums up important benefits to meeting in person:

"I do not think there is a better format for promoting our science and industry than meeting face-to-face. To me, it's more fun and interesting to see people in person rather than virtually."

Here's to a great upcoming season for AGS. See you in-person!

Sincerely, Monte D. Mabry

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Call for volunteers to serve on the 2024 AGS Pathfinders Committee

You will help steer this new "Hall of Fame for Alaskan Geoscientists". It's fun and not too demanding! https://www.alaskageology.org/pathfinders



About Pathfinders in Alaska Geology.

This award was established in 2023 to recognize true trailblazers in the geosciences in Alaska; men and women who made enormous contributions to the general understanding of the geology of the Last Frontier.

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A TRIBUTE TO ALAN E.H. PEDDER (1932-2023), CANADIAN PALEONTOLOGIST AND STUDENT OF FOSSIL RUGOSE CORALS EXTRAORDINAIRE

Robert B. Blodgett¹ and Francisco Javier Cuen Romero²

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²Departamento Geologia, Universidad de Sonora, Hermosillo, Sonora, Mexico <u>francisco.cuen@ciencias.uson.mx</u>

In this short tribute we note the recent passing of Alan E.H. Pedder on July10, 2023 in the town of Sydney, Vancouver Island, British Columbia, Canada. Alan was among one of the World's leading specialists in the study of fossil Cnidaria, notably Devonian rugose corals.

Alan was born April 30, 1932 in Miri, Sarawak, Borneo where his family resided while his father was working in an oil field for Shell Oil Company. Most of his youth was spent in England and his favorite place there as in St. Ives. As a child he remembers being stafed by a German Messerschmitt fighter while playing on the beach in Cornwall, coast of southern of England. His earliest college education was in England (University of Cambridge, graduated 1954), but he completed his Ph.D. 1968 at the University of New England, Armidale, N.W., Australia.

His work record is as follows:

1954-55: Petroleum geologist, B.P. United Kingdom

1955-62: Petroleum geologist, Triad Oil Co. Ltd., Calgary

1962-67: Demonstrator, University of New England, Armidale, Australia

1968-1995: Research Scientist, Geological Survey of Canada, Calgary

Elected Canadian representative on the International Committee on Fossil cnidarians. Served 1971-6

Elected Chairman of the IUGS Subcommission on Devonian Stratigraphy, 1988

Invited Chairman of "International Symnposium on the Devonian System and its Economic Oil and Mineral Resources", Guilin, 1992, sponsored by the National Stratigraphic Committee of China and the Guangxi Association for Science and Technology

His legacy also includes the develop world's most comprehensive computer database for Devonian corals occurrences. This is an invaluable tool for coral biostratigraphy and paleozoography. Our community sadly lost a pillar of paleontology.

Publications related to Alaskan Devonian corals:

Pedder, A.E.H., 2006, Zoogeographic data from studies of Paleozoic corals of the Alexander terrane, southeastern Alaska and British Columbia, in Haggart, J.W., Enkin, R.J., and Monger, J.W.H., eds., Paleogeography of the North American Cordillera: evidence for and against large-scale displacements. Geological Association of Canada Special Paper 46, p. 29-57, appendix C, p. 1-45.

Blodgett, R.B., Boucot, A.J., Rohr, D.M., Pedder, A.E.H., 2010, The Alexander terrane of Alaska-A displaced fragment of Northeast Russia? Evidence from Silurian-Middle Devonian megafossils and stratigraphy.

Blodgett, R.B., Rohr, D.M., Measures, E.A., Savage, N.M., Pedder, A.E.H., and Chalmers, R.W., 2000, The Soda Creek Limestone, a new upper Lower Devonian formation in the Medfra quadrangle, west-central Alaska, p. 1-9, in Pinney, D.S., and Kauth, P.K., eds. Short Notes on Alaska Geology: Alaska Division of Geological & Geophysical Surveys Professional Report 119.

Significant Rugose Corals publications:

Oliver, W.A., Jr., and Pedder, A.E.H., 1984, Devonian rugose coral biostratigraphy with special reference to the Lower-Middle Devonian boundary. Geological Survey of Canada Paper 84-1A, p. 449-452.

Oliver, W.A., Jr., and Pedder, A.E.H., 1994, Crises in the Devonian history of the rugose corals. Paleobiology, v. 20, p. 178-190/

Pedder, A.E.H., 1977, Systematics and biostratigraphic importance of the Lower Devonian rugose coral genus Exilifrons. Geological Survey of Canada Paper 77-1B, p. 173-180.

Pedder, A.E.H., 1982, The rugose coral record across the Frasnian/Famennian boundary, p. 485, in Silver, L.T., and Schultz, P.H., eds., Geological Implications of Impacts of Large Asterioids and Comets on the Earth: Geological Society of America Special Paper 190.

Pedder, A.E.H., 1983, New Dalejan (Early Devonian) rugose corals from the Blue Fiord Formation of Southwestern Ellesmere Island, Northwest Territories. Geological Survey of Canada Paper 83-1B, p. 223-236.

Pedder, A.E.H., 1984, Dehiscens Zone corals from the Lower Devonian of Yukon Territory. Geological Survey of Canada Paper 84-1B, p. 315-325.

Pedder, A.E.H., 1985, Lower Devonian rugose corals of Lochkovian age from Yukon Territory. Geological Survey of Canada Paper 85-1A, p. 587-602.

Pedder, A.E.H., 1989, New genera of Middle Devonian rugose corals from the type Horn Plateau Reef, District of Mackenzie. Geological Survey of Canada Bulletin 396, p. 61-87.

Pedder, A.E.H., 1998, New and revised Lower Devonian Rugosa from Western North America and Tasmania: Journal of Paleontology, v. 72, no. 2, p. 224-245.

Pedder, A.E.H., 1999, Paleogeographic implications of a Devonian (Givetian, Lower varcus Subzone) rugose coral fauna from the Ma'der Basin Morocco), in North Gondwana: Mid-Paleozoic terranes, stratigraphy and biota, in Feist, R., Talent, H.A., and Daurer, A., eds., Abhandlungen der Geologischen Bundesanstalt, v. 54, p. 385-434.

Pedder, A.E.H., 2010, Lower-Middle Devonian rugose coral faunas of Nevada. Contribution to an understanding of the "barren" E Zone of the Choteč Event in the Great Basin. Bulletin of Geosciences, v. 85, no. 1, p. 1-26.

Pedder, A.E.H., 2017, Benthic biostratigraphy of the upper Eifelian (Devonian) Hume Formation at Hume River (type locality), northern Mackenzie Mountains, Northwest Territories, Canada. Stratigraphy, v. 14, nos. 1-4, p. 349-364.

Pedder, A.E.H., 2019, Systematics, biostratigraphy and significance of discoid and partly discoid corals from the Devonian of northwestern Canada, Ural Mountains Russia and southeastern Australia. Bulletin of Geoscience, v. 94, no. 2, p. 137-168.

Pedder, A.E.H., and Feist, R., 1998, Lower Devonian (Emsian) Rugosa of the Izarne Formation, Montagne Noire, France. Journal of Paleontology, v. 72, no. 6, p. 967-991.

Pedder, A.E.H., and McLean, Ross, 1982, Lower Devonian cystiphyllid corals from North America and eastern Australia with notes on the genus Uraratuia.

Pedder, A.E.H., and Murphy, M.A., 1998, Lochkovian Rugosa of Nevada. Geological Society of America Special Papers, v.

Pedder, A.E.H., and Murphy, M.A., 2003, The Papiliophyllidae (Lower Devonian Rugosa): Their systematic and reinterpreted biostratigraphic value in Nevada: Journal of Paleontology, v., p. .

Pedder, A.E.H., and Murphy, M.A., 2004, Emsian (Lower Devonian) Rugosa of systematic and stratigraphic ranges, and reassessment of faunal provincialism. Journal of Paleontology, v.78, p. 838-865.

Pedder, A.E.H., and Oliver, W., 1990, Rugose coral distribution as a test of Devonian palaeogeographic models: Geological Society of London Memoirs, v. 12(1), p. 267-275.



Alan Pedder wrapping up field samples in Craig, Prince of Wales Island, Southeast Alaska, 2003.



Alan collecting silicified Middle Devonian (Givetian) stringocephalid brachiopods on Prince of Wales Island, 2003.



Two Devonian rugose coral specialists, William A. Oliver Jr. of the USGS (left) and Alan Pedder (right) several decades ago.



Alan Pedder at work in his office at the GSC in Calgary studying Devonian corals.

Alaska Geological Society

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The Alaska Geological Society is an organization which seeks to promote interest in and understanding of Geology and the related Earth Sciences, and to provide a common organization for those individuals interested in geology and the related earth sciences.

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Contact membership coordintor Kirk Sherwood with changes or updates (e-mail: membership@alaskageology.org; phone: 907-240-2546)

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Schlumberger

Alaska Geological Calendar of Events

Date	Time	Organization	Event	Location			
Oct. 30, 2023	11:30 am	AGS	Elizabeth Miller, Stanford University. "The Brooks Range, Alaska: An orogenic belt with a complex history"	Virtual Google Meet			
Nov. 28, 2023	11:30 pm	AGS	Bernard Coakley, UAF. Schist and Central Belt theme.	BP Energy Center & Google Meet			
Dec. 14, 2023	11:30 am	AGS	Trystan Herriott DGGS. Zircon-based Chrono-stratigraphy theme	BP Energy Center & Google Meet			
Jan. 25, 2024	11:30 am	AGS	Esther Babcock, Logic Geophysics & Analytics,LLC. Environmental Geophysics theme	BP Energy Center & Google Meet			
Feb. 15, 2024	11:30 am	AGS	Aeon Russo UAA. "Significance of High Latitude Submarine Groundwater Discharge"	BP Energy Center & Google Meet			

AMA: Alaska Miners Association; AGS: Alaska Geological Society: GSA: Geophysical Society of Alaska

AAEP: Alaska Association of Environmental Professionals; SPE Society of Petroleum Engineers;

UAA University of Alaska Anchorage.

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Membership renewal is November 1; annual dues are: Full member - \$25 Student member - \$5 Lifetime membership - \$250



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