New Detrital Zircon Ages Indicate Potential for Expansion of the Upper Triassic Hyd Group Along Strike from Hyd Group Host Rocks of the Palmer Prospect, Southeast Alaska

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Abstract

New stratigraphic studies and U-Pb detrital zircon ages for rocks at the Palmer Zn-Cu-Pb-Ag-Au volcanogenic massive sulfide (VMS) prospect, north of Haines, Alaska, and in rocks along strike from the Palmer prospect indicate potential for wider regional distribution of the Upper Triassic Hyd Group that hosts the VMS occurrences on the Palmer property. The rocks along strike with the prospect are currently mapped with the Paleozoic Porcupine Slate unit. The Hyd Group hosts the massive sulfide bodies at the Greens Creek mine and other massive sulfide occurrences in the Alexander Triassic Metallogenic Belt (ATMB), which extends for more than 600 km in southeast Alaska.

On the Palmer property stratigraphic sections in the Hyd Group vary within a few km. The Palmer section consists of several hundred meters of basalt and volcaniclastic rocks that are overlain by meter-scale U-Pb-dated Late Triassic rhyolite flows and associated baritic massive sulfide bodies, in turn overlain by argillite, basalt flows, calcareous siltstone, tuff, Late Triassic conodont-bearing limestone, additional basalt flows, volcaniclastic rocks, and a thin cap of thin-bedded black limestone. The Late Triassic rocks are overlain by a polylithic debris flow that contains a single Early Jurassic zircon population at ~195 Ma. The section at the occurrence named AG consists of meter-scale basalt flows interlayered with andesite and rhyolite breccia and flows, in turn overlain by basalt with associated baritic massive sulfide bodies, volcaniclastic rocks, tuffaceous and exhalative rocks, and capped by more than 100 m of carbonaceous argillite that contains Late Triassic *Heterastridium?* sponges. The Pump Valley section overlies an unconformity on Paleozoic limestone and consists of limestone-clast-bearing conglomerate overlain by limestone, several hundred meters of basalt flows with subordinate volcaniclastic rocks, and a cap of several hundred meters of carbonaceous argillite that includes a sample containing a youngest zircon population at ~145 Ma. A lack of pre-Triassic zircons in the Jurassic samples from these sections suggests the underlying Paleozoic rocks were not exposed during deposition of the Jurassic rocks. The lack of evidence for an unconformity or intervening deformation event and the apparent depositional continuity of Jurassic sediments on the Hyd Group in the Pump Valley and Palmer sections suggest deposition of the Jurassic sediments in pre-existing Triassic basins.

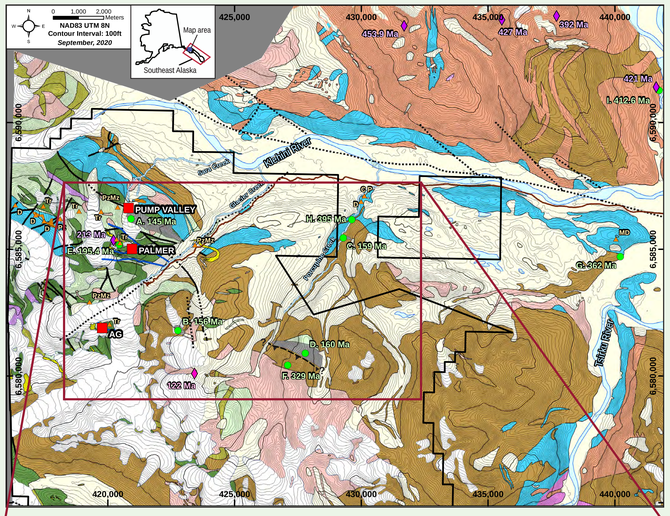
The Triassic Hyd Group on the Palmer property overlies a regional stratigraphic section that extends for more than 50 km along strike, consisting of Devonian mafic volcanic rocks, Upper Devonian fossiliferous limestone, Mississippian limestone, chert and argillite, and Devonian to Permian black argillite, chert, siltstone, and carbonate of the Porcupine Slate. With the exception of the immediate area of the Palmer prospect, all rocks in this region that overlie the Devonian limestone are currently mapped as part of the Porcupine Slate. In Porcupine Creek, seven km east of the Palmer prospect, argillite at the basal contact of the Porcupine Slate on Devonian limestone yielded a youngest zircon population at ~395 Ma. Argillite one km upstream contains zircon populations at ~159 Ma, ~169 Ma, ~182 Ma, and oldest zircons at 227 Ma. Zircons from the matrix of a volcaniclastic conglomerate five km upstream from the basal contact have a dominant zircon population at ~160 Ma. This conglomerate stratigraphically overlies thin-bedded fetid black limestone and sooty pyritic argillite that are typical of the Hyd Group and is structurally overlain by interbedded limestone and siltstone that have a youngest zircon population of ~329 Ma. These new geochronologic data indicate the Porcupine Creek section includes at least two horizons of Jurassic rocks within what was previously mapped as Paleozoic Porcupine Slate. This distribution of rock types and ages suggests that massive sulfide-hosting Triassic rocks could be present between the Paleozoic and Jurassic rocks in Porcupine Creek and along strike in the region.

Early Jurassic sedimentary and volcanic rocks were not previously known from the Palmer property, the ATMB, or the Alexander terrane. The lack of mineralization associated with the Jurassic rocks suggests the magmatic-hydrothermal system that produced the Triassic massive sulfide bodies at the Palmer prospect did not persist into the Jurassic. The age range of Jurassic zircon populations indicates intervals of magmatic activity from earliest to latest Jurassic. A possible explanation for Jurassic magmatic activity may be earlier initiation of the Gravina arc on the Alexander terrane than was previously known. The Jurassic ages thus define an important new stratigraphic element for the Alexander terrane and provide an upper stratigraphic boundary for the Triassic Hyd Group and associated VMS deposits.

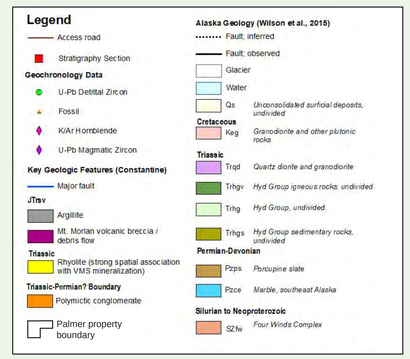
Rusty-colored rocks to the right of the Saksaia Glacier show the location of the Palmer section.

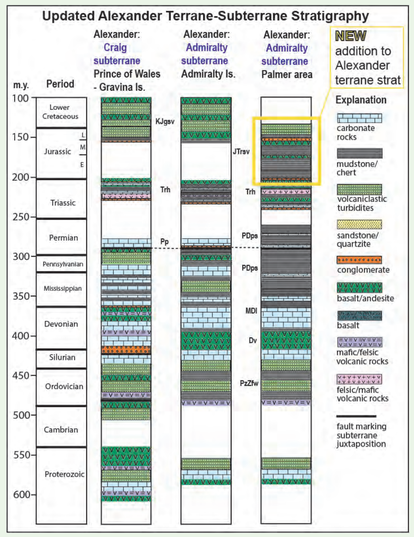
Polylithic debris flow, Mount Morlan, overlies layered tuff (photo credit: Garfield MacVeigh)

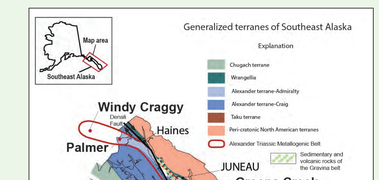
17SK319A: Limestone, chert, plagioclase porphyritic andesite, and volcaniclastic clasts in debris flow, Mount Morlan



Generalized geologic map of the Palmer property and adjacent areas, modified from Redman et al., 1985







19SK077A: Siltstone and argillite turbidites

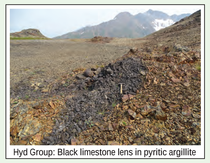
17SK314A: Siltstone and argillite turbidites

19SK093: Volcaniclastic turbidites

19SK093D: Polymictic conglomerate

Hyd Group: Rhyolite lapilli tuff breccia

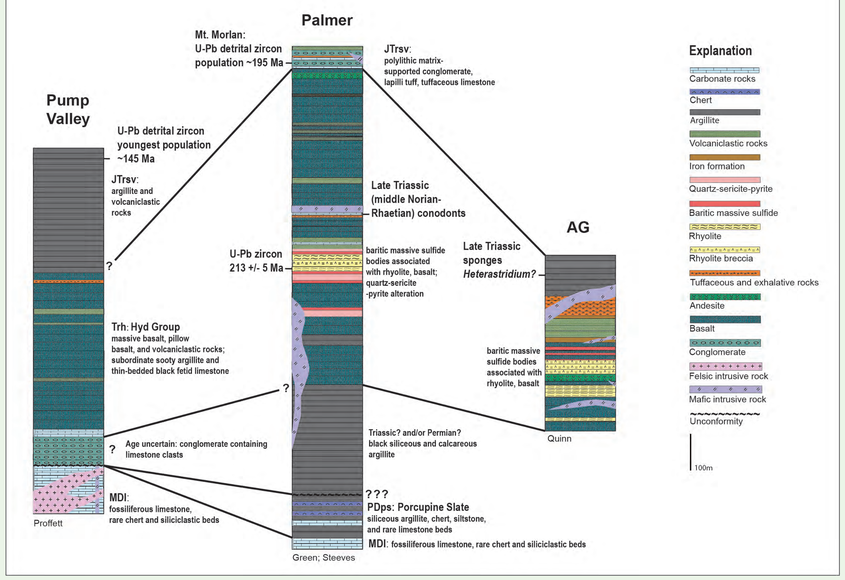
Hyd Group: Pillow basalt



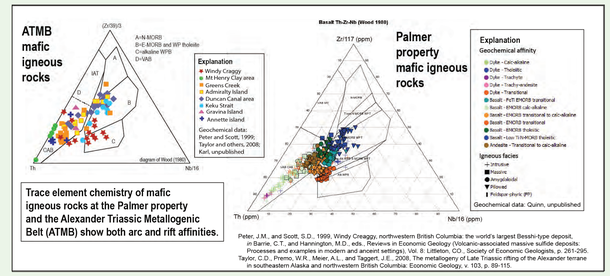
Hyd Group: Black limestone lens in pyritic argillite

Hyd Group: Interbedded limestone and argillite

Hyd Group: Pyritic argillite with tuff layers



The apparent continuous deposition of carbonaceous mudstone from the Late Triassic to the latest Jurassic suggests a long-lived, quiet-water, low-oxygen depositional environment. The lack of evidence for exhumation of underlying rocks in the detrital zircon populations in the Jurassic rocks suggests they were deposited in pre-existing basins.

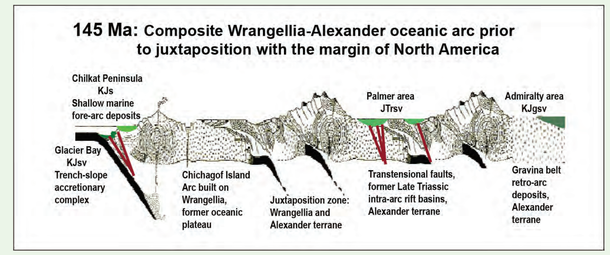


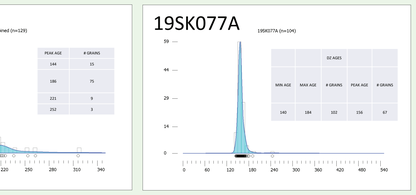
Trace element chemistry of mafic igneous rocks at the Palmer property and the Alexander Triassic Metallogenic Belt (ATMB) show both arc and rift affinities.

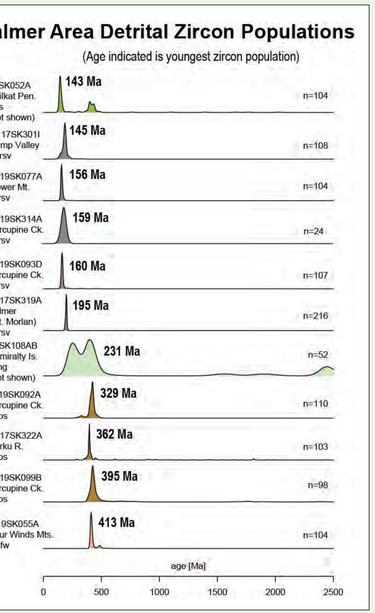
Peter, J.M., and Scott, S.D., 1999, Windy Craggy, northwestern British Columbia: the world's largest Besshi-type deposit, in Barrie, C.T., and Hannington, M.D., eds., Reviews in Economic Geology (Volcanic-associated massive sulfide deposits: Processes and examples in modern and ancient settings), Vol. 8: Littleton, CO., Society of Economic Geologists, p. 261-295. Taylor, C.D., Premo, W.R., Meier, A.L., and Taggart, J.E., 2008, The metallogeny of Late Triassic rifting of the Alexander terrane in southeastern Alaska and northwestern British Columbia: Economic Geology, v. 103, p. 89-115.

Significance of Results

- **Jurassic sedimentary rocks on the Palmer property and surrounding area lack zircons older than Triassic, in contrast with Jura-Cretaceous sedimentary rocks that 1) overlie Wrangellia near Haines and 2) overly the eastern Alexander terrane in the Gravina belt, which do contain Paleozoic and Precambrian zircons.**
- **Zircon populations that are no older than Triassic in the Jurassic rocks on the Palmer property and surrounding area suggest these rocks were locally sourced and that underlying Paleozoic rocks were not exposed at the time of deposition. The continuity of deposition and lack of evidence for an intervening deformation event suggest the Jurassic sediments filled pre-existing basins that formed in the Late Triassic.**
- **The location of Jurassic rocks along strike from Jurassic and Triassic rocks on the Palmer property suggests that Upper Triassic rocks that may contain VMS deposits also continue along strike, parallel to the strike of the underlying Paleozoic rocks.**







The lack of zircons older than Late Triassic in the Jurassic argillites suggests the lack of exhumation of underlying rocks supporting a lack of deformation or unconformity between the Upper Triassic Hyd Group and the Lower Jurassic sedimentary rocks.

Detrital zircon populations at ~145, ~156, ~160, ~169, ~182, and ~195 Ma in the Jurassic argillites indicate continuing intervals of magmatic activity. The lack of mineralization in the Jurassic rocks suggests the magmatic-hydrothermal system that produced the Late Triassic massive sulfide bodies did not persist into the Jurassic. One possibility to explain the Early Jurassic magmatic activity is that the Gravina arc was initiated on the Alexander terrane earlier than was previously known.

Reference cited:

Redman, E.C., Gilbert, W.G., Jones, B.K., Rosenkrans, D.S., and Hickok, B.D., 1985, Preliminary bedrock geologic map of the Skagway B-4 quadrangle: Alaska Division of Geological & Geophysical Surveys, Report of Investigations 84-31, 1 sheet, scale 1:40,000.