New bedrock mapping highlights the importance of brittle and ductile structure in the tectonics and metallogeny of the eastern Yukon-Tanana Upland, Alaska

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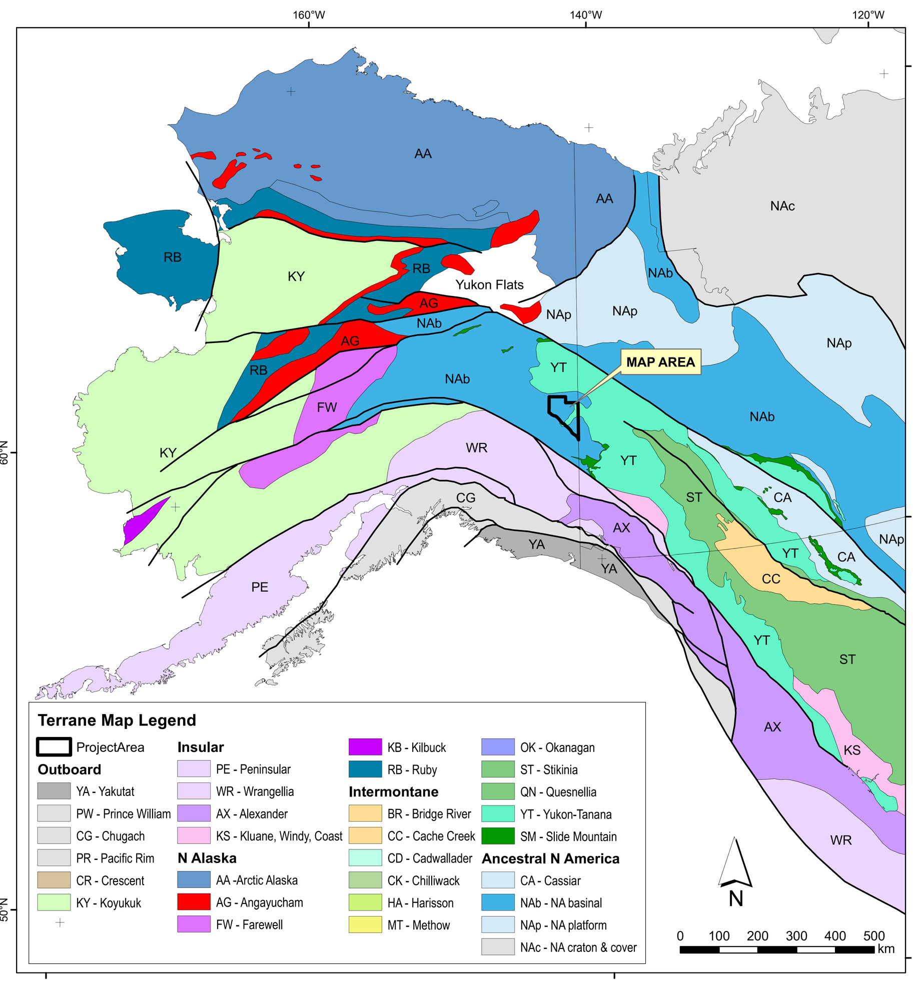
ABSTRACT

The Alaska Division of Geological & Geophysical Surveys (DGGS) presents new draft bedrock geologic mapping for a 4,800 km2 (1,900 mi2) portion of the Yukon-Tanana Uplands lying between Tok, Alaska and the Alaska-Yukon border. The area is of exploration interest for its potential mineral resources, including porphyry copper-molybdenum-gold, orogenic- and intrusion-related gold, volcanogenic massive sulfides, and rare-earth-elements. The area is of interest to Cordilleran tectonics because it presents complex (though poorly exposed) rocks reflecting the tectonic assembly and subsequent dismemberment of the Yukon-Tanana Uplands metamorphic province, as well as the emplacement of multiple magmatic arcs during mid-Paleozoic through Paleogene time.

Mid-Paleozoic amphibolite-facies gneiss and amphibolite of the Lake George assemblage, part of parautochthonous North America, occupy the lowest structural level in the map area. The Ladue unit (a component of the allochthonous Yukon Tanana Terrane and possibly the along-strike equivalent of the Fortymile River assemblage) is a partially retrograded amphibolite-facies assemblage dominated by Devonian to Mississippian felsic orthogneiss, which overlies the Lake George assemblage on a low angle mylonitic shear zone. A chlorite schist-dominated unit contains felsic metavolcanic rocks with Permian zircon ages; this greenschist facies unit is the apparent continuation of the allochthonous Klondike schist across the border in Yukon.

The area is intruded by voluminous mid-Cretaceous plutons of granodiorite to granite composition. Plutonic rocks locally preserve weak foliation, suggesting emplacement during the waning stages of deformation. Multiple generations of hypabyssal dikes (mostly felsic) of mid-Cretaceous to Paleocene age intrude the plutonic and metamorphic rocks. Coarse-grained plutonic rocks of latest Cretaceous age occur at Mount Fairplay and apparently also within strands of the Sixtymile-Pika fault system.

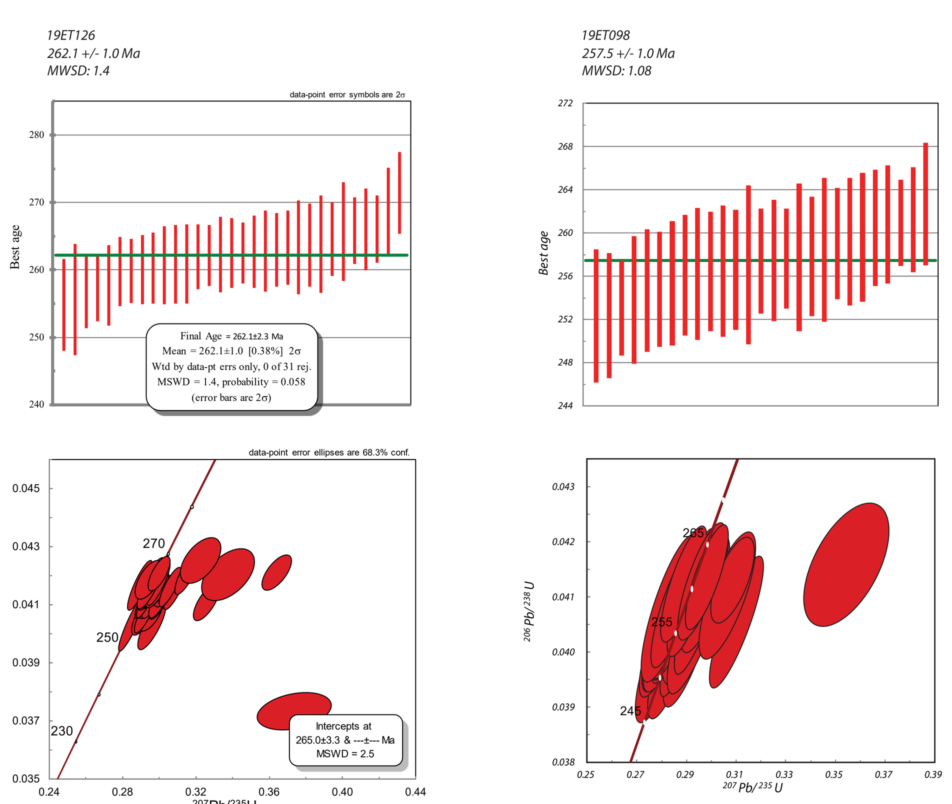
Middle Cretaceous to Paleocene volcanic rocks and local volcanic-rich sedimentary rocks unconformably overlie the metamorphic and plutonic rocks, mainly in the northern half of the map area. Where mappable, the unconformity and measured bedding surfaces dip moderately, suggesting significant post-Paleocene tilting related to Cenozoic high angle faulting. This faulting may also help explain the juxtaposition of coeval volcanic and plutonic rocks within the map area.



GEOCHRONOLOGY

36 new U-Pb zircon ages (preliminary, plotted on map) generated in collaboration with University of Arizona Laserchron and Sean Regan at University of Alaska Fairbanks

Highlights:
- Granite porphyry south of Mt Fairplay (Tp of Foster, 1970) dated at ~112-114 Ma
- New ca. 70 Ma ages associated with porphyry Cu-Mo mineralization at Oreo
- Felsic dike at Goodrich prospect dated at 106 Ma
- New Permian ages from felsic metavolcanic rocks help to map the extent of Klondike Assemblage in eastern Interior Alaska (data below)



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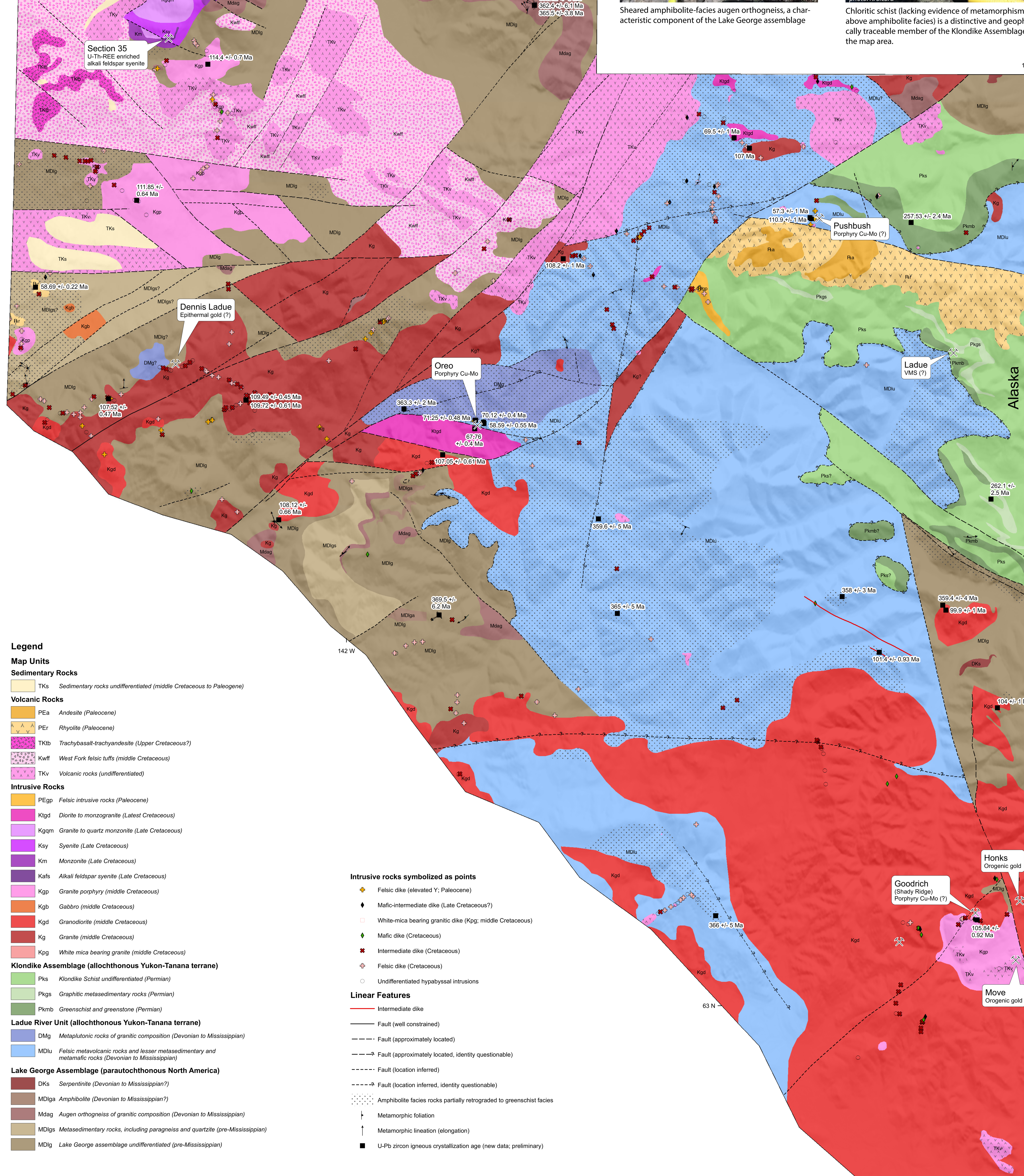
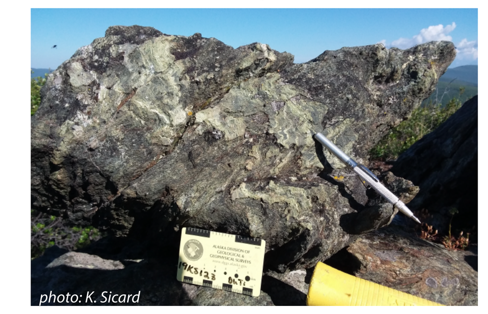


Lake George Assemblage

Sheared amphibolite-facies augen orthogneiss, a characteristic component of the Lake George assemblage

Klondike Assemblage



Chloritic schist (lacking evidence of metamorphism above amphibolite facies) is a distinctive and geophysically traceable member of the Klondike Assemblage in the map area.

Altered and mineralized hypabyssal intrusive rock exposed in a trench at the Pushbush porphyry Cu-Mo prospect.

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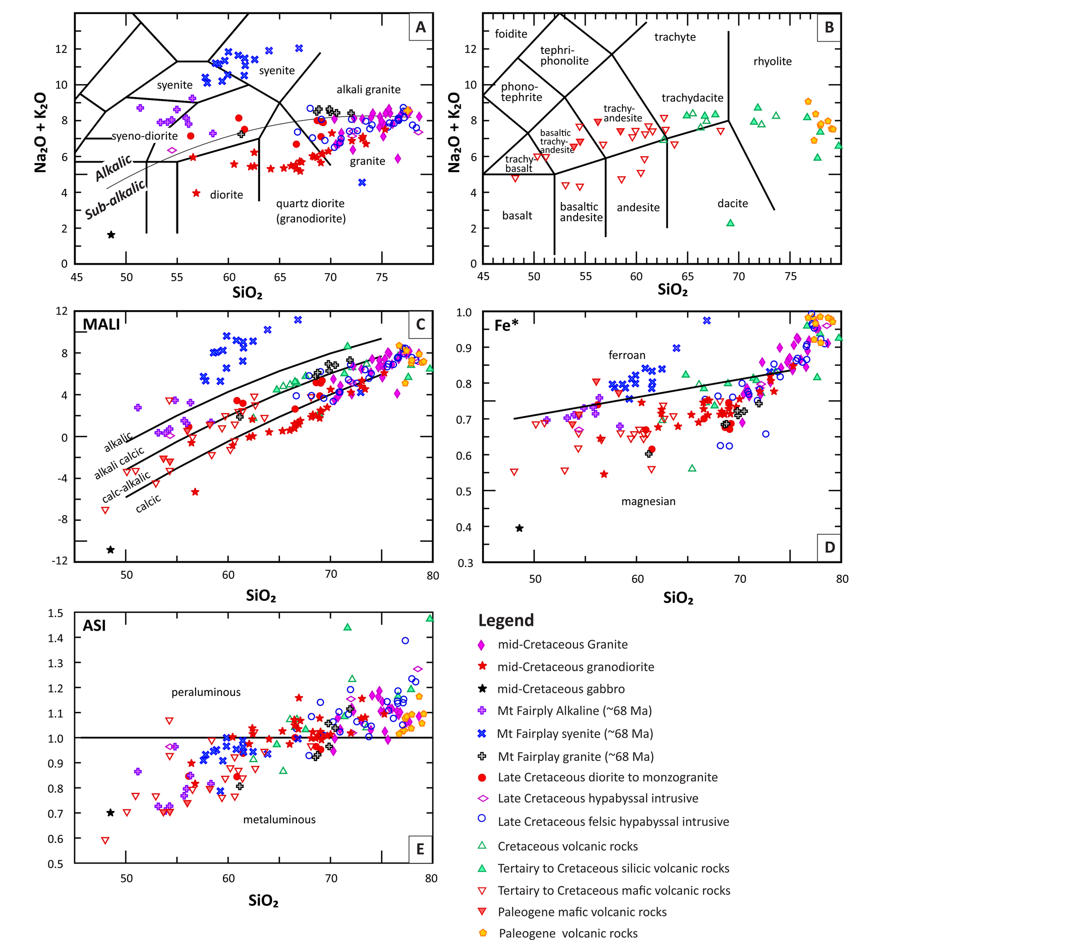
Ladue River Unit

Felsic metavolcanic rocks, upper greenschist to amphibolite facies with variable greenschist overprint, are a dominant lithology of the Ladue River unit in the map area.

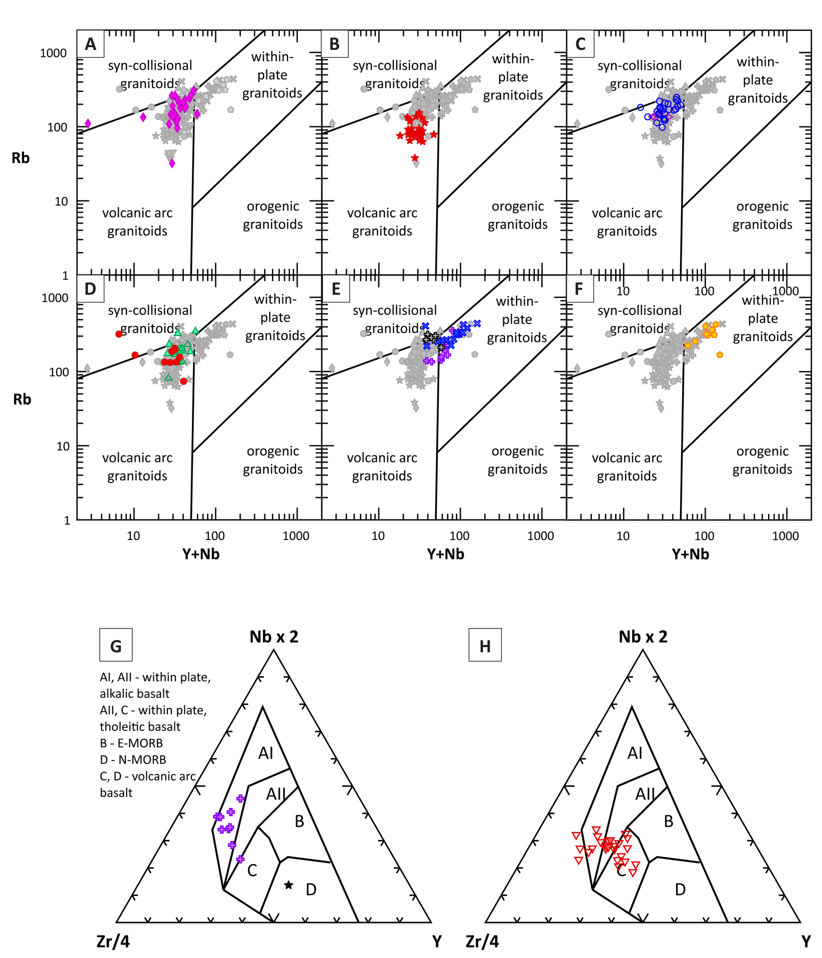
Mylonites

Mylonitic shear zone separating the Ladue River unit from the underlying Lake George assemblage. Field observations (sigma clasts, fold vergences) indicate top-to-the northwest shear sense. Mylonites occur at both terrane bondaries and within metamorphic units throughout the map area.

GEOCHEMISTRY OF IGNEOUS ROCKS



Above: Classification of igneous rocks from eastern Tanacross map area. A. total alkali versus silica diagram (Wilson, 1989) showing the compositional range of the plutonic rocks; B. total alkali versus silica diagram of LeBas and others (1986) showing the range of volcanic rock composition, C. modified alkali-lime index (MALI = Na2O + K2O - CaO; Frost and others, 2001); D. Fe*= (FeO + 0.8998 x Fe2O3) / (FeO + 0.8998 x Fe2O3 + MgO)(Frost and others, 2001); and E. aluminum saturation index diagram (ASI = Al2O3 x 9.808 / (Na2O x 16.134 + K2O x 10.6157 + CaO x 17.8319 - P2O5 x 11.765); Frost and others, 2001) . The data has been normalized to 100 % anhydrous, with total Fe2O3 recalculated into FeO and Fe2O3 following the LeMaitre (1976) method.



Above: Tectonic classification diagrams for igneous rocks from the eastern Tanacross area. A. Pearce and others (1984) classification for mid-Cretaceous granites; B. Pearce and others (1984) classification for mid-Cretaceous granodiorite; C. Pearce and others (1984) classification for Late Cretaceous hybabyssal intrusions; D. Pearce and others (1984) classification for Late Cretaceous diorite to granite and volcanic rocks; E. Pearce and others (1984) classification for Mt Fairplay syenites and granites; F. Pearce and others (1984) classification for Paleogene volcanic and intrusive rocks, G. Meschede (1986) classification for Mt. Fairplay syenites and H. Meschede (1986) classification for Cretaceous to tertiary mafic volcanic rocks. Symbols and colors as above.

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