

Geochronology of the Western and Central Brooks Range, Alaska: Implications for the Geologic Evolution of the Anarraaq and Red Dog Zn-Pb-Ag Deposits

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Abstract

A compilation of published geochronology of rocks and minerals from the western and central Brooks Range provides a framework for understanding the complex history of the Brooks Range and northern Alaska. A simplified timeline of events comprises (1) Devonian extension, (2) Mississippian extension and Zn-Pb-Ag mineralization, (3) a passive interval, (4) pre-Brooks Range orogeny rock-formation and thermal event, (5) inception of Brooks Range orogeny, (6) exhumation and the end of main-stage deformation, and (7) subsequent episodic deformation. This compilation is supplemented by new $^{40}\text{Ar}/^{39}\text{Ar}$ dates of white mica from the Anarraaq and Red Dog Zn-Pb-Ag (+ barite) deposits from the western Brooks Range. The deposits are hosted in black shale and carbonate rocks of the Late Mississippian-Early Pennsylvanian Kuna Formation. Quartz-pyrite-white mica grains in sedimentary rocks above the Anarraaq deposit yield an age of 195.0 ± 2.0 Ma, and paragenetically late quartz-pyrite-white mica from the Main orebody at the Red Dog deposit has an age of 126.1 ± 0.7 Ma. These white micas are much younger than the age of Zn-Pb-Ag mineralization at Red Dog (338 ± 5.8 Ma Re-Os age of pyrite). The date for white mica from Anarraaq (~ 195 Ma) appears to be related to a large-scale thermal event in the region immediately before the inception of the Brooks Range orogeny. The white mica from the Red Dog deposit (~ 126 Ma) correlates with the later stages of the orogeny, a period of blueschist metamorphism, extension, and rapid exhumation, which varied with geographic location. These dates suggest that the Red Dog deposits underwent significant hydrothermal overprinting during multiple episodes of the Brooks Range orogeny.

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