

**AAPG Annual Convention
Salt Lake City, Utah
May 11-14, 2003**

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Association of Deformation and Fluid Events in the Central Brooks Range Fold and Thrust Belt, Northern Alaska

The central Brooks Range consists of two superposed north-directed contractional orogens, one formed between 140-120 Ma and the other at ~ 60-45 Ma. The older orogen was an arc-continent collisional zone characterized by far-traveled allochthons and relatively low structural relief. The younger orogen is a retroarc thrust belt with relatively low amounts of shortening and high structural relief. Folding and thrusting of the younger episode is superimposed on the thin-skinned deformational wedge of the earlier orogen and also produced a frontal triangle zone in a thick sequence of mid-Cretaceous foreland basin sediments to the north.

Stable isotope compositions of calcite and quartz veins indicate two fluid events including: (1) an earlier, higher-temperature (~ 250-300°C) event that produced veins in deformed Devonian clastic rocks, and (2) a younger, lower-temperature (~ 150°C) event that deposited veins in deformed Mississippian through Albian strata. The fluids in the first event had variable δO^{18} values, but nearly constant δC^{13} values buffered by limestone lithologies. The vein-forming fluids in the second event had similarly variable δO^{18} values, but with distinctly lower δC^{13} values as a result of oxidation of organic matter and/or methane.

Zircon fission track ages demonstrate cooling to temperatures below 200°C between 140-120 Ma for the Devonian rocks, whereas zircon and apatite fission track ages show that Mississippian to Albian rocks were never heated above 200°C and cooled below 110-90°C at ~ 60-45 Ma. These data are interpreted as indicating that the older, high-temperature fluid event was active during thrusting at 120-140 Ma, and the younger fluid event during deformation at ~ 60-45 Ma.