

Archean continental rifting recorded by cordierite-quartz gneiss, central Wyoming, USA

FROST, C. D.*¹, MCLAUGHLIN, J. F.¹, SHELTON, C. R.¹, ALLEN, C. M.², SWAPP, S. M.¹ AND FROST, B. R.¹

¹Department of Geology and Geophysics, University of Wyoming, Laramie WY USA, frost@uwyo.edu

²Institute for Future Environments, Queensland University of Technology, Brisbane, Australia

Cordierite-quartz gneiss, an unusual metamorphic rock type, has been discovered to occur in thin (1-5 m wide) bands within the Mesoarchean Sacawee block of central Wyoming. The gneiss is spatially associated with mafic rocks and small volumes of garnet-biotite schist within extensive outcrops of 3.3-3.4 Ga quartzofeldspathic orthogneiss. The rocks are silica-rich (70-79% SiO₂). In some samples cordierite is well-preserved, whereas in others it is variably replaced by sericite and chlorite. Biotite is a minor phase; in some samples muscovite and/or sillimanite are also present. The rocks are rich in MgO (3.1-8.3 %) and are Na₂O- and especially CaO-poor. U-Pb ages of zircon from four samples of cordierite-quartz gneiss are 3.3 Ga, although one sample also contains minor age populations of 3.1 and 2.9 Ga zircon.

Two additional samples of Mg-rich quartzose schist preserve sedimentary structures. One, a phyllitic sandstone from the Goldman Meadows Formation at South Pass, contains quartz pebbles and mud clasts now composed of chlorite in a matrix of chlorite and muscovite. It contains 3.3 Ga and older detrital zircons. The other, a bedded sandstone from Tin Cup Mountain in the western Granite Mountains, is composed of quartz, biotite, and cordierite. Detrital zircons are mainly 2.86 Ga. Similar major and trace element compositions to the other cordierite-quartz gneiss samples permit the interpretation that all are metasedimentary rocks.

We propose that these unusual rocks record rifting and sedimentation along the Wyoming province continental margin. Seawater hydrothermal metasomatism removed Ca and added Mg to form quartz-chlorite pelitic schist after 2.86 Ga. Subsequent regional metamorphism between 2.65 and 2.63 Ga formed cordierite-quartz gneiss. Sillimanite in many cordierite-quartz gneiss samples suggests maximum T and P of 660°C and 4 kb. Similar origins by Mg-metasomatism and prograde metamorphism have been proposed for occurrences of cordierite-quartz gneiss in west Greenland; Orijärvi, Finland; Bergslagen, Sweden; and the Ammonoosuc Formation of New England.