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Multiple pyroxene and amphibole assemblages in the amphibolite facies: Bulk compositional controls

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ABSTRACT

This paper presents studies of samples from different localities of the Garnet-Amphibole-Magnetite (GAM)-Quartzite Member of the Ammonoosuc Volcanics from southern New England, USA. Based on stratigraphic and geochemical evidence, earlier workers interpreted the Ammonoosuc Volcanics as part of a volcanic island-arc complex. As such, these rocks have a highly varied stratigraphy with a wide spectrum of chemical compositions. During subsequent metamorphism, these rocks reached amphibolite-facies conditions (6 kbar and 580–640 °C). Within the Ammonoosuc Volcanics, a fine-grained, garnet-, magnetite-, and amphibole-bearing quartzite forms a distinct stratigraphic horizon. The quartzite commonly shows delicate millimeter- to centimeter-thick layering, which is interpreted as an original depositional feature that could have formed by precipitation from solutions enriched in silica, iron, and manganese. Volcanic detritus that was rich in Al, Ca, Mg, and Na could account for the variation in concentration of these elements, which are present along with Fe, Mn, and Si in some laminae of these quartzites.

The mineralogy of layers within these quartzites can vary greatly on the scale of several centimeter. The most mineralogically complex layers contain, in addition to quartz, garnet, and magnetite, and one or more of the amphiboles cummingtonite, anthophyllite, or hornblende. In the most recent investigations of these rocks, both orthopyroxene and clinopyroxene have been identified in a few samples. A comparison of Mn contents of minerals that are common to different assemblages indicates that the pyroxenes are present in bulk compositions rich in Mn. The Mn content of the bulk composition is the most important factor controlling the mineralogy, and increasing the Mn content causes changes in the mineralogy that mimic the same progression of assemblages that is seen in mafic rocks undergoing the amphibolite- to granulite-facies transition.