$^{40}Ar/^{39}Ar$ ages and the paragenetic sequences in a multi-staged hydrothermal breccia in central Maine

J.C. Lennon[1], P.H. Reynolds[1] and D.C. Roy[2]
[1]*Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia B3H 3J5, Canada*
[2]*Department of Geology and Geophysics, Boston College, Chestnut Hill, Massachusetts 02167, U.S.A.*

The multi-stage Abbot Breccia in central Maine is exposed in a 30 by 80 m outcrop in sharp contact with the early Devonian Madrid Formation. The Madrid and other local metasedimentary rock formations are the predominant source of the fragments. The fragments are commonly angular to subangular, elongate, and open-packed. The four mineral assemblages of the hydrothermal cement are predominantly composed of either biotite, chlorite, albite, or quartz, with lesser to minor calcite, muscovite, siderite, hematite, sulphidic opaques, rutile, and apatite. At least two brecciation events have been identified in the Abbot Breccia. The larger second-stage breccia is cemented dominantly by the quartz assemblage. However, the western contact of the second-stage breccia shows a 2 to 3 m wide zone of aligned fragments that are cemented by the biotite, chlorite, and albite assemblages; this zone is <1 m wide along the remainder of the contact. The biotite, chlorite, and albite assemblages form a consistent paragenetic sequence of hydrothermal cements around most of the breccia fragments. The paragenetic sequences of cement and alteration assemblages are comparable to that of alkaline porphyry copper deposits, suggesting that the hydrothermal fluids exsolved from a nearby felsic pluton. The breccia may have been formed by the collapse of a vapour cavity at the apical portion of a cooling pluton. Potassic and phyllic hydrothermal alterations of greenschist minerals within the metasedimentary rock fragments, deformation fabrics in these fragments, and the absence of metamorphism or deformation fabrics in the matrix indicate that the breccia formed after folding and metamorphism of the Madrid Formation during the Acadian Orogeny. Conventional $^{40}Ar/^{39}Ar$ age spectra of bulk mineral separates provide ages of 395 Ma to 400 Ma for hydrothermal muscovite, which is consistent with the known ages (400 Ma to 360 Ma) of the Acadian plutons in central Maine. However, single grain $^{40}Ar/^{39}Ar$ ages for hydrothermal biotite from the same separates range from 430 Ma to 460 Ma, which predates the late Silurian - early Devonian age of the adjacent Madrid Formation. The apparently older hydrothermal biotite may represent excess argon.