Multiple Episodes of Clay Alteration at the Precambrian/Paleozoic Unconformity, Appalachian Basin: Isotopic Evidence for Long-Distance and Local Fluid Migrations

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Abstract: Chlorite and illite are commonly associated with ubiquitous secondary K-rich feldspar in the rocks located immediately above and below the Precambrian-Paleozoic unconformity in southwestern Ontario, and elsewhere in the mid-continent of North America. This alteration assemblage is attributed to long-distance migration of hot brines driven westward by orogenic processes originating along the eastern seaboard of North America. The δD and $\delta^{18}O$ values of chlorite and illite, plus K-Ar dates for secondary K-rich feldspar and illite, were used to determine the nature, origin, and timing of the fluids that altered Precambrian granites and their overlying rocks in southwestern Ontario. The $\delta^{18}O$ values of the chlorite-forming fluids are best explained by initial hot brines ($\geqslant$150° C) evolved mostly from seawater. Secondary K-rich feldspar formation followed shortly thereafter, as the fluids cooled and perhaps mixed with meteoric water. Regional migration of the brines was induced by Taconic orogenic events to the east. The hydrogen and oxygen isotopic compositions for the secondary illite of the early to mid-Carboniferous indicate its crystallization from local meteoric water at low temperatures (40 – 55° C). Infiltration of local meteoric water into the Paleozoic and uppermost altered Precambrian rocks occurred during uplift, erosion, and subaerial exposure of local arches in southern Ontario. The local basement reactivation and associated secondary illite formation in this portion of the North American hinterland was likely a distal expression of east-coast Acadian and Alleghanian orogenic activity.

Key Words: Alteration • Brines • Chlorite • Illite • Isotopes • Meteoric Water • Precambrian Unconformity • Ontario

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