Rb-Sr and Re-Os ages of fault gouges and copper mineralization from the Paradox Basin, Utah

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Clay-rich fault gouge and sulfides associated with copper mineralization in the eastern Paradox Basin were dated using Rb-Sr and Re-Os, respectively. Multiple analyses of leached residues of the clay size fraction with the greatest percent of likely authigenic 1Md illite (Reitveld modeling of randomly oriented XRD data) yielded an imprecise age for the Moab fault of 60 ± 17 Ma (initial $^{87}Sr/^{86}Sr$ of 0.7166 ± 0.0052, MSWD = 0.21) , and the data combined from three faults of the Lisbon Valley fault system (Lisbon Valley, GTO, and Keystone faults) yielded a more precise age of 50.9 ± 3.5 Ma (initial $^{87}Sr/^{86}Sr$ of 0.71144 ± 0.00033, MSWD = 0.16). The leachates of all four faults are identical within uncertainty and average 0.7095, indicating that the leachable minerals (e.g. calcite) in the fault gouge had a likely origin from mixing of evaporite derived fluids with more evolved country rock derived fluids. The illite-rich clay residues from the four faults also had overlapping initial $^{87}Sr/^{86}Sr$ values consistent with derivation of authigenic illite solely from the evolved country rock derived fluids.

Bornite from the Lisbon Valley mine gave a Re-Os isochron age of 47.5 ± 1.5 Ma with a very elevated initial $^{187}Os/^{188}Os$ value of 12.8 ± 2.4 (MSWD = 1.06). The age of sulfide mineralization is identical within uncertainty of the age of the authigenic illite Rb-Sr ages from the nearby faults and support hypotheses that during episodes of displacement, these faults likely served as fluid conduits for copper mineralization in the Lisbon Valley area near the end of the Laramide Orogeny. The extremely radiogenic initial $^{187}Os/^{188}Os$ value of the bornite indicates precipitation from fluids derived from evolved source rocks with time integrated, large Re/Os ratios, and that the source of copper in the Paradox Basin may have been source rocks such as shales.