Submitted to12th Goldschmidt Conference, Davos 2002

Geochemical Measurements of ^{130}Te Half-life: Present Status

A. P. MESHIK, C. M. HOHENBERG,
O. V. PRAVDIVTSEVA, AND T. J. BERNATOWICZ

Washington University, CB1105, One Brookings Drive, Saint Louis, MO 63130, USA, am@wuphys.wustl.edu

Geochemically determined ^{130}Te half-lives have yielded two clusters of values at $2.5 \pm 0.4 \times 10^{21}$ y and $8 \pm 1 \times 10^{20}$ y. Mechanisms of Xe loss and Xe inheritance have both been suggested in attempts to explain this dichotomy. If some ^{130*}Xe was inherited from pre-existing minerals inferred ^{130}Te half-lives would be too short; if Xe losses occurred the values would be too long. Both are subject to experimental test.

Tellurides which yield "short" ^{130}Te half-life are the best candidates for inherited ^{130}Xe. The shortest, Kalgoorlie kren-nerite ($T_{½} = 3.3\times10^{20}$y, Bernatowicz et al, 1993) and Kochbu-lak native Te ($T_{½} \approx 3\times10^{20}$y, Meshik et al, 2002), however, yield mixing lines between unique radiogenic and trapped Xe components with no evidence for ^{130*}Xe excess.

The best samples to look for Xe losses are those that have "long" inferred ^{130}Te half-lives. Native Te from Good Hope and American mines, Colorado, with the longest ^{130}Te half-lives ever observed (2.99 and 3.22×10^{21} y, Bernatowicz et al, 1993), were neutron irradiated to convert ^{130}Te into ^{131*}Xe. The ^{130*}Xe/^{131*}Xe ratios were constant in all step-wise extrac-tions, even the lowest, which leads us to conclude that ^{130*}Xe has not been partially lost by diffusion (Meshik et al, 2002).

Neither Xe inheritance nor partial loss seems to be responsible for disagreement among measured ^{130}Te half-lives. However the constant ^{130*}Xe/^{131*}Xe observed in diffusion experiments on irradiated samples only indicates the absence of *partial* diffusion losses. *Total* loss of the ^{130*}Xe would be undetectable by this method. The long ^{130}Te half-lives were derived assuming that the Colorado Te samples were undisturbed since their formation 1.7 Ga ago. However recent thermochronological studies of the Colorado Front Range (Shaw et al, 1999) reveal several additional thermal episodes, one of them at ~1.4 Ga with associated peak temperatures of 550°C, well above melting point of native Te. Model Pb-Pb age (1.7 Ga) for Colorado samples seem not to have been affected by that event. Even a more gentle, ~300°C, thermal episode may cause complete loss of ^{130*}Xe that is difficult to detect. Evidence for this possibility is that the older samples tend to give longer ^{130}Te half-lives. Younger samples usually have better documented thermal history, and in that context, may provide the more reliable ^{130}Te half-life. Supported by NASA grant NAG594424.

References

Bernatowicz T., Brannon J., Brazzle R., Cowsik R., Hohen-berg C., & Podosek F. (1993) *Phys.Rev. C*, 47(2), 806–25.

Meshik A., Hohenberg C., Pravdivtseva O., Bernatowicz T. (2002) *Lunar & Planetary Sci. Conf. 33*, abstract #1342.

Shaw C. A, Snee L. W., Selverstone J., and Reed J. C, Jr. (1999) *Journal of Geology* 107, 49–67.