Effect of co-contaminants on *in situ* phosphate-based immobilization of uranium: Dissolution kinetics of autunite in the presence of tributyl phosphate

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Polyphosphate remediation technology has been proposed as a promising method to attenuate uranium within the subsurface at the Hanford site, southeastern Washington state. This technology works by directly sequestering the existing aqueous uranium in autunite and meta-autunite group minerals,

$$X_{3-n}^{(n)+}\,[(UO_2)(PO_4)]_2 \cdot xH_2O.$$

Under these conditions the long-term fate of uranium in subsurface pore waters is limited by the rate of dissolution. However, many anthropogenically altered settings are related to former nuclear energy and weapons production facilities where disposal practices involved co-disposal of inorganic and organic waste streams. At the Hanford site tributyl phosphate (TBP) was used to recover uranium from high level radioactive wastes and is a legacy co-contaminant present in the subsurface. During recovery operations TBP was used to complex uranium within the waste stream for later separation. It is hypothesized that the presence of TBP in the subsurface may increase the dissolution rate of autunite; thereby, decreasing the long-term efficacy of polyphosphate remediation technology. The effect of complexing agents such as organic material has been shown to increase the dissolution kinetics of autunite minerals [1]. The purpose of this investigation was to quantify the dissolution kinetcs of natural calcium meta-autunite, $Ca[(UO_2)_2(PO_4)_2]_2 \cdot 3H_2O$, as a function of pH (7 -10) and temperature (5 – 90°C) in the presence and absence of TBP. Results presented here illustrate the significane of pH and TBP on the dissolution kinetics of meta-autunite.

[1] D. M. Wellman, J. P. Icenhower, A. P. Gamerdinger & S. W. Forrester (2006) *American Mineralogist* **91**, 143-158.

An Indosinian orogenic belt in the northeastern Qinghai-Tibet plateau, China: Geochemical and geochronological evidence

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The Zongwulong tectonic belt situated in between the Northern Qaidum Tectonic Zone and the Southern Qilian orogen is composed of Carboniferous ophiolite (Rb/Sr age:318±3Ma), and Permian arc intermediate-acid volcanics (zircon U-Pb age of 248.5 Ma) as well as late Paleozoic and early-middle Triassic strata. The ophiolite suite represents an assemblage of ultramafic-mafic lava diabase dykes and siliceous rocks. The basaltic volcanics are identified as high $^{143}Nd/^{144}Nd$ N-MORB ($\varepsilon_{Nd(350Ma)}$ =6.1~8.4) with high ΣREE contents, and characterized by an obvious Dupal anomaly ($\varepsilon^{208}Pb/^{204}Pb$=46~103 and $\varepsilon^{207}Pb/^{204}Pb$ 4~18 $^{87}Sr/^{86}Sr$ >0.704). The Permian intermediate-acid volcanics display geochemistry of the Andes-type arc. Three Hercynian-Indosinian granites (A/CNK ≈ 1): the Tianjun-nanshan (248±6.2 Ma), Qinghaihunanshan (238±1.5 Ma) and Erlangdong (215±0.78 Ma) granites outcropping in the southern Zongwulong belt are associated with subduction and post collision stages, respectively. In addition, two obvious deformation phases represent the Indosinian orogenic structures and Tertiary intracontinental tectonic imprints.

Different from the Northern Qaidum Tectonic Zone to its south and the Qilian Orgen to its north, the Zongwulong tectonic zone is an independent Indosinian organic belt which was developed on the early Paleozoic Caledonian orogenic basement and experienced a complete plate tectonic evolution of continental rifting, oceanic basin and sunduction-collision.

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[1] Guo AL, Zhang GW & Sun YG *et al.* (2007) *Science in China* (D) **50** (Supp II), 1-13.