Application of infra-red spectral and multi-element analyses in the gold exploration in North Mara mines, Tanzania

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A combination of Short Wavelength Infra red (SWIR) spectral and multielement analyses was used to characterize certain hydrothermal alteration, pathfinder elements and their distribution within gold deposits in the Archean Musoma-Mara greenstone belt in Tanzania. The aim was to fingerprint hydrothermal systems responsible for the formation of major gold deposits in the belt. The SWIR spectra of white mica and chlorite from the samples revealed compositional zoning which reflects pH changes associated with hydrothermal fluid-rock interaction during mineralization. White mica crystallinity is variable in the deposits reflecting thermal gradient during hydrothermal alteration. On the other hand, gold pathfinder elements distribution showed extension of pathfinder element signature beyond a distance of 600 m width from the ore zone with either As and Sb association or Ag and Bi association. This suggests that different redox conditions have affected the deposits. This study confirms that a combination of SWIR spectral and multielement data is a cost-effective method in generating mineralization targets and can be applicable in areas with similar styles of mineralization.

Calibrating U-series tools for weathering rate and duration on a soil sequence of known ages

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The U-series isotopes provide a range of potential tools with which to assess the timing and rate of chemical weathering. Using such tools commonly involves making assumptions about the leaching coefficients of the nuclides from the soil, for instance that leaching is first order with respect to U concentration [1]. No study has yet tested these assumptions or the general applicability of U-series tools to weathering questions, on a soil sequence with known ages.

In this study we have measured U and Th isotopes on a set of 24 samples taken from four soil profiles from the Merced chronosequence in the Central Valley (California) [2]. These soils are formed from granitic to dioritic sands deposited on river terraces with ages of 40, 250, 600 and 3000 kyrs. This chronosequence has been extensively studied for trace element, mineralogical and textural variables and so makes an ideal test bed for U-series tools for weathering. We have augmented our new U-series data with bulk chemical analysis from which loss of U and Th in the soil profiles can be assessed.

The U-series data show few clear patterns within each soil profile but show a clear trend in average (^{230}Th/^{238}U) values for each soil profile from an original high value of 1.37 at 40 kyr to lower values with increasing duration of weathering (1.16, 1.07 and 1.04 respectively). These values are not consistent with a uniform leaching constant for ^{238}U, but suggest early rapid leaching followed by slower leaching at a rate more comparable to that of Th. This can be modelled as a two stage leaching process (which would require rapid early release of U from easily weathered mineral phases early in soil formation) or by using non-linear leaching constants. Such variable weathering rates are consistent with losses of U and Th normalised to Ti.

This and future chronosequence work will allow more accurate use of U-series nuclides to assess weathering rates and durations in settings where the timescales of weathering are not independently known.

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