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Timing of calcrete development using U-Th-isochrone method: results and limitations from two sites in peninsular India

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Th-230/U dating method has been widely used on pedogenic carbonate to provide accurate and precise age constraints on environmental changes during the late Quaternary. U-Th investigations have been carried out on multistages calcrete profiles from the semi-arid part of peninsular India. The basic assumptions are that (1) samples have remained closed for U and Th isotopes, and (2) adequate correction is made for initial Th-230, using common thorium (Th-232) as an index isotope for detrital contamination. Isochron techniques and development diagrams were used as the samples exhibit high ^{232}Th concentrations (0,16-2,30 ppm) with activity ratios (^{230}Th/^{232}Th) from 0,19 to 3,85 and low ^{238}U concentrations (150-840 ppb). U-Th isotopic ratios were obtained by Thermal Ionisation Mass Spectrometry (TIMS). The coeval subsamples required for the isochron age determination underwent the Total Sampling Dissolution Method. The initial isotopic composition of the detrital phase, estimated from Rosholt type 2D isochron graph (^{230}Th/^{232}Th vs ^{238}U/^{232}Th) displays some variability for different horizons from a same profile. Data plotted on Osmond type 3D graph (^{230}Th/^{238}U vs ^{234}U/^{238}U vs ^{232}Th/^{238}U) also suggest that the detrital phase is never at secular equilibrium, with ^{230}Th/^{238}U > 1 and ^{234}U/^{238}U < 1 at Gundlupet site, and ^{230}Th/^{238}U < 1 and ^{234}U/^{238}U > 1 at Coimbatore site. This is in contrast with the classical assumption of the isochron method, and may be explained by (1) the incorporation of highly disequilibrated detrital material into the growing carbonate, tending toward the secular equilibrium, or (2) a posterior remobilization of isotopes. However,

the coeval subsamples defined regression lines statistically valuable (MSWD $\leq$ 1). The ages obtained for Coimbatore profile range from 304$\pm$38 Ka to 44$\pm$3 Ka (2σ) and are in full agreement with the evolutionary sequence based on micromorphological and mineralogical observations, and highlight the distinct chronological stages for this profile. The reliability and the significance of isochrons and derived ages are discussed on those observations.