

The age of Os isotope reason in the sub-continental lithospheric mantle.

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The development of the multi-collector ICP-MS has enabled the in-situ dating of mantle wall-rocks using the Re-Os isotope system. The technique involves the in-situ analysis of sulfides using a laser ablation microprobe attached to the mass spectrometer. The sulfides are time capsules: like zircons in crustal rocks they record many events in the lithospheric mantle. Apart from dating the depletion events that formed the volume of lithosphere the sulfides provide constraints on a range of processes that might modify the mantle such as the addition of metasomatic fluids during lithosphere reworking. The in-situ analysis allows the isotopic data to be interpreted within a microstructural context and in the framework of geochemical data from other microanalytical techniques.

Age-relative probability diagrams can be produced using sulfides that are interpreted to be monosulfide solid solutions that represent residual phases from partial melting or that crystallized from sulfide melts. These sulfides typically (but not exclusively) occur as enclosed grains in silicates and have high Os (tens-thousands of ppm), low Re/Os ($^{187}\text{Re}/^{188}\text{Os} < 0.08$) and low Pt/Os (< 0.5). The event patterns provide the basis for identifying lithosphere stabilization episodes and for the comparison of the evolution of different lithospheric terranes. Superimposed on the record obtained from the primary sulfides is the post-stabilisation history preserved in many interstitial (and some enclosed) sulfides. They typically have low Os, highly radiogenic Os isotopic compositions and high Pt/Os. The isotopic data indicate that there are multiple generations of sulfides in most mantle peridotites and the whole-rock Re-Os ages thus reflect a mix of these different sulfide populations: in many samples the in-situ data yield older ages for original lithospheric mantle stabilization. This has significant implications for linking crust-mantle evolution and identifying mantle terranes with different histories.