Evolution of lithospheric mantle beneath SE margin of South China Block: in situ Re-Os evidence

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Earth's continents are underlain by "roots" 100-250 km thick of depleted mantle rocks, and the properties and history of these roots affect the long-term stability of the continents. Recent advances in analytical technology make it possible to measure the age of single grains of sulfide minerals in mantle-derived rocks, and thus to trace the history of the continental roots (Pearson et al., 2002). Analysis of fragments of mantle rocks brought up by Miocene intra-plate basalts on the Penghu Islands in the Taiwan Strait has been carried out by novel high-precision in situ techniques for the Re-Os isotopic ratios. The Os isotope compositions of sulfides in the spinel peridotites reveal the presence of Proterozoic subcontinental lithospheric mantle (SCLM) beneath the highly extended southeast margin of the South China Block (SCB).Despite the recent Os disturbance, both TMA model ages for individual sulfides and model ages estimated from the initial 187Os/188Os ratios of Re-Os mixing lines require that some volumes of the SCLM formed prior to 2.3-1.9 Ga. These sulfide age data indicate that at least part of the SCLM beneath the thinned margin of the SCB is as old as some crust in its interior and has survived the Mesozoic Yanshanian magmatism and subsequent extension and crustal thinning. Later major events in the SCLM may be recorded by TRD model ages of 1.5–1.2 Ga and ca. 0.9 Ga, which are consistent with the range of Nd and Hf model ages of overlying crust on the SCB (Chen and Jahn, 1998; Griffin et al., 2002). Notably, the 0.9 Ga event recorded by the Os model age of some unique subchondritic Ni/Co sulfides, which is proposed to originate from deeper mantle, is consistent with age of the proposed mantle plume that led to the breakup of Rodinia (Li et al., 1999) and may represent the first isotopic evidence from the lithospheric mantle for this event. Therefore, in situ sulfide Os ages may actually date metasomatic events in the SCLM, related to mantle thermal events that also affected the crust.The results show that depleted parts of the underlying SCLM retain mid-Proterozoic ages, while other, less depleted parts, also indicating by fertile features of some peridotites, are much younger. The mixture of ages and rock types suggests that during the stretching of the lithosphere, the ancient continental root was partly disrupted and replaced by younger material, but stayed attached to the lower crust. The oldest mantle ages for the lithosphere beneath the Taiwan Strait are similar to ages from the mainland interior. This implies that the ancient mantle beneath the continental margin of SCB survived even where major volcanic activity took place. The results are directly relevant to current debates about the geodynamics of the continents, and the long-term evolution of the upper mantle.References:Chen, J., & Jahn, B.-M., 1998, Tectonophysics, 248, 101–133.Griffin, W.L., et al., 2002, Lithos, 61, 237–269.Pearson, N.J. et al., 2002, GCA, 66, 1037–1050.Li, Z.X. et al., 1999, EPSL, 173, 171-181.