Recycled old zircon convected through upper mantle, within podiform chromitite in Luobusa ophiolite, Tibet

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In this study, over 100 zircons were discovered by heavy mineral separation of podiform chromitite in Luobusa ophiolite. The discovery of accessory zircons in chromitites allowed us to date the formation of the chromitite and history of tectonic evolutions. Here we report the zircons with unusually old age.

20 zircon grains in chromitites from No. 1 site were analyzed. Zircons from the chromitites in Luobusa ophiolite are usually euhedral-subhedral and some are rounded. The color is slightly brownish or colorless. Cathodoluminescence images of these zircons indicate that some zircons have clear oscillatory zoning, whereas other zircons show apparent homogeneous overgrowth. U-Pb dating of these zircons by LA-ICP-MS yielded two different ages. One group has relatively younger age, 107-534Ma, which plots nearly on a concordia line. Another group has older age 1460-1822Ma, which plots off the concordia line. Grain size is different between yonger zircons and older ones. Older zircons are slightly larger than younger ones, and are about 100-200um across. There is insignificant difference of apparent ages within a single zircon grain.For example, a zircon has 1650 Ma in the core, whereas does 1654 Ma in the rim. There was not any correlation between CL image and the U-Pb age. We identified several mineral inclusions, quartz, feldspar, mica, apatite, within both yonger and older zircons using laser-Raman spectrometry. No high-pressure minerals or mantle minerals were identified. This means that these unusually old zircons were formed in low-pressure crustal emvironment. Where did the zircons come from?

It has been recognized that this ophiolite was formed at 110-120 Ma based on radiolaria in cherts overlying the pillow lavas (ALLEGRE et al., 1984; ZIABREV et al., 2003). In this study, the minimum age of 107 Ma, which we obtained from zircon in chromitites, is consistent to the age of the ophiolite. But, all other ages of zircons are much older than that of ophiolite. Yang et al. (2001) also reported U-Pb zircon ages of 450-910 Ma and Re-Os iridosmine age of 400 Ma from chromitites in Luobusa ophiolite. Mineral inclusions within zircons are crustal materials, which means that these zircons were crystallized in the low pressure crustal condition. Thus these zircons within chromitites are interpreted as xenocrysts from old crustal materials

Recently, old-age zircons (330 to 1600 Ma) were reported from the Mid Atlantic Ridge MORBs (PILOT et al., 1998). They may have derived from old continental crustal material, which have assimilated with the MORB magma during ascent. YU et al. (2001) reported that zircons from chromitites in Luobusa ophiolite have shorter inter-atomic distances of Zr-O and Si-O bonds. As a result, they concluded that Tibetan-zircons were derived from the high-pressure mantle environment. Judging from the line of evidence mentioned above, it is highly possible that these zircons captured by chromitites were originated from recycled crustal materials, convecting through upper mantle.

Based on paleogeography of the Eurasian continent and recycled zircons obtained from chromitites in Luobusa, we propose the new model of geological histry of Luobusa ophiolite; Lhasa block and Indian continent were once northern part of the Gondwanaland, which had large subduction zone (about 280Ma). This subduction brought crustal materials into the mantle below the Gondwanaland. As a result the mantle belew the Gondwanaland was metasomatized and old zircons were transfered into the mantle. About 120 Ma, Luobusa ophiolite was generated in Tethys overlying the metasomatized mantle. Around the same time chromitites was formed and captured the zircons within the metasomatized mantle. At last, Indian continent collided with Asian margin, which made ITSZ (about 40Ma).