The record of early crustal evolution preserved in detrital zircons from Mount Murchison metasedimentary rocks, Western Australia

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The Mt. Narryer and Jack Hills metasedimentary belts of the Narryer Terrane of Western Australia have been the subject of intense study for almost thirty years because they contain ca. 4.35 Ga detrital zircons, which are the oldest minerals known on Earth. These rocks also contain numerous younger populations of Hadean and Archean detrital zircons of diverse provenance, preserving a rich archive of information on early crustal evolution. Largely ignored has been a third major sequence of metasedimentary rocks in the Narryer Terrane, located at Mt. Murchison, 27 km south-southeast of Mt. Narryer and 98 km southwest of the Jack Hills. The detrital zircon population at Mt. Murchison can provide insights into the extent of Hadean sources in the Narryer Terrane, and whether magmatic events that produced detrital zircons in this region were episodic or continuous during the Archean.

The Mt. Murchison metasedimentary belt is 5 km long and 2 km wide, and contains fuchsitic quartzite, bedded coarse-grained quartzite, glassy quartzite, and quartz pebble conglomerate that appear similar in appearance to mature clastic units at Mt. Narryer and the Jack Hills. We have determined the U-Pb ages of detrital zircons in a sample of fuchsitic quartzite from Mt. Murchison using laser ablation-inductively coupled plasma mass spectrometry. One-hundred-thirty-nine detrital zircon grains in the sample are concordant within 10%. Seventy percent of the grains have $^{207}Pb/^{206}Pb$ ages that fall within four populations: 3125 ± 40 Ma (16%), 3235 ± 40 Ma (23%), 3445 ± 40 Ma (18%) and 3540 ± 40 Ma (13%). The oldest grain has a $^{207}Pb/^{206}Pb$ age of 3955 ± 12 Ma (2s); the youngest grain is 3001 ± 20 Ma (2s).

The detrital zircon population of the Mt. Murchison sample differs from those of quartzites and conglomerates from Mt Narryer and the Jack Hills in the paucity of grains older than 3.6 Ga, and the presence of a large population of 3.1 – 3.2 Ga grains. On the other hand, the 3.4 Ga age peak in the Mt. Murchison sample is also a prominent detrital zircon age population in the Jack Hills, and 3.5 Ga sources contributed to all three metasedimentary belts. This suggests that while there was significant age heterogeneity in the detrital sources of the Narryer Terrane, there were also some common sources that linked the paleodrainage systems of the Mt. Murchison, Mt. Narryer and Jack Hills areas.

When combined, the detrital zircon age data for all three metasedimentary belts define a rather continuous record of major magmatism in the Narryer Terrane from *ca.* 3100 to 3650 Ma. This implies unusually long-lived and continuous (rather than episodic) magmatic processes for crustal growth in the early Archean. Reconstructing the record of ages of clastic sedimentary sources in ancient terranes requires analysis of multiple depositional units of paleodrainage systems.

PGE abundances in upper mantle xenoliths from the Carpathian-Pannonian Region

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The contents of Os, Ir, Ru, Rh, Pt and Pd were determined in lherzolite xenoliths and their sulfide grains (up to 150 μm) from the Carpathian-Pannonian region (CPR) to evaluate the abundance of the highly siderophile elements in the subcontinental lithospheric mantle beneath the region of the Alpine-Mediterranean area. The studied locations include the Styrian basin (western CPR, Austria), Bakony—Balaton-Highland (central CPR, Hungary), Nógrád-Gömör (northern CPR, Hungary, Slovakia), and the East-Transylvanian basin (eastern CPR, Romania).

Total PGE contents range between 7 and 21 ppb regardless of location. Ir-type PGEs are overall high, 5-12 ppb, which confirms the residual mantle nature of the xenoliths. The ratio of Ir- and Pd-type PGEs varies between 0.83 and 2.83. Os/Ir ratios in xenoliths from Styrian and East-Tranylvanian basins are slightly below the chondritic ratio, whereas those from Bakony—Balaton-Highland are above the chondritic value. Ru/Ir is ca. 30 % higher than the chondritic value in the majority of xenoliths from Styrian and East-Transylvanian basins. In contrast, xenoliths from the Bakony—Balaton-Highland show chondritic Ru/Ir, except xenoliths most strongly depleted in Al. These PGE ratios do not show correlations with Al. Pt and Pd contents and their ratios with Ir-type PGEs correlated with Al, as expected, due to incompatible nature of Pt and Pd during partial melting in the Bakony—Balaton-Highland xenoliths, which have the widest range in Al contents. In situ PGE analyses on sulfide grains (mss, chalcopyrite and pentlandite) show positive correlations of Os, Ir, Ru and Rh, except in sulfides from the Bakony—Balaton-Highland and some sulfides from Nógrád-Gömör and East-Transylvania, whereas Pt and Pd correlate poorly with the Ir-type PGEs. The total concentrations of PGEs range between 4 and 796 ppm. The majority of the PGE patterns show high and variable abundances of Os, Ir, Ru and Rh, with decreasing abundance from Rh to Au and a strong negative Pt anomaly. Sulfides in xenoliths from the Bakony—Balaton-Highland, being basically mss, show a smooth negatively sloped PGE pattern from Os to Au.

Whole-rock and in situ sulfide grain analyses demonstrate that the upper mantle beneath the CPR shows a district-scale variation in PGE abundances. Although the xenoliths show no evidence for modal metasomatism, the variation can be explained by different degrees of partial melting and cryptic metasomatism.