U-Pb age, Hf-isotope and trace-element composition of zircon megacrysts from the Juina kimberlites, Brazil

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Forty zircon megacrysts were recovered from the diamondiferous Pandrea kimberlitic pipes comprising the Chapadão cluster in the Juina District. The Juina District in the Mato Grosso State is one of major diamond-producing areas in Brazil [1]. The recovered zircons were analysed sequentially by determination of U-Th-Pb isotopic ratios via LAM-ICPMS, and by Lu-Hf isotopic analysis via LAM-MC-ICPMS.

Under the cold cathode luminescence (CL) microscope, zircons have brownish, yellowish and rarely pinkish colours, with yellowish hues predominating. Most of the investigated crystals are homogeneous, suggesting their growth under stable conditions.

The U-Pb age determinations for zircons from the three different Pandea pipes are almost identical (93.5 ± 0.7, 93.7 ± 0.7 and 93.7 ± 0.7 Ma), with a weighted mean age of 93.6 ± 0.4 Ma (95 % confidence; MSWD = 0.83; probability 0.76) that is significantly older than the age of other, barren and weakly diamondiferous, kimberlites in the Juina area.

The Hf isotopic composition of the Juina zircons well corresponds to the average kimberlitic trend, according to data by Griffin *et al*. [2]. Both the initial $^{176}Hf/^{177}Hf$ values (average $^{176}Hf/^{177}Hf$ = 0.282911 ± 22) and εHf (range from +5.9 to +8.3) fall between the values expected for a chondritic reservoir, and those expected for zircons crystallized from magmas with a depleted-mantle source.

The trace-element composition of Juina zircons, characterised by low REE, U (6–30 pm) and Th (2–12 ppm) contens, is typical of mantle-derived zircons [3].

[1] Kaminsky *et al.* (2001) *Contrib. Miner. Petrol.* **140**, 734-753. [2] Griffin *et al*. (2000) *Geochim. Cosmochim. Acta* **64**, 133-147. [3] Belousova *et al*. (2002) *Contrib. Miner. Petrol.* **143,** 602-622.

Geochemical signatures of oceanic crust zircon

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Zircons were separated from oceanic gabbros of modern sulfide ore field dragged at 13°N MAR. All studied zircons may be divided into two crystal types: short to long prismatic weakly colored grains with dominating well preserved prismatic facets, CL images show typical magmatic planar/sectorial zoning (I); yellow-brownish grains of mainly hyacinth-type with ill-defined facets and edges. Zoning in CL is concentric, primary magmatic but overlapped by bright irregular stripes in the outer zones (II). Grains are different in size but <150 μm. Proportion of these zircon types varies significantly.

U-Pb age of two zircon groups confirms its genetic difference: group I ages are not older 1 Ma (the best value 861±29 Ky), group II is characterized by pre-Mesozoic ages. Majority of dated grains have the ages 2700±20 and 1750±12 Ma. Geochemical features of two zircon groups are also very different. Group I has U content of 450÷850, rarely up to 1800 ppm and Th/U 0.7÷2.95, whereas group II U<350 ppm and Th/U is 0.4÷0.9. Zircon II demonstrates enriched REE patterns with weakly pronounced Ce peak: [Ce/Ce]* 1÷12 (group I 30÷90) and weak negative Eu anomaly: [Eu/Eu]* 0.1÷0.07 (group I <<0.1); LREE distribution has flat character, while zircon I shows sharply fractionated LREE distribution ($[Sm/La]_n$ 1÷150 and 100÷750). Degree of HREE fractionation for zircon of both groups is similar: $[Lu/Gd]_n$ 2÷30. Young zircon is characterized by higher U/Yb>>1.0, but on diagrams Y or Hf *vs* U/Yb all our zircons are out of the oceanic crust field due to their high U. Zircon crystallization temperature (Ti-in) corresponds to 700°C for group I and 800-850°C for group II. Measured $^{176}Hf/^{177}Hf$ ratio increases from 0.281115 to 0.283397. Whereas for the young and 2700 Ma-old zircon the source may be directly compared with the depleted mantle, for the 1750 Ma-old zircon this source was more enriched (ε=+0.2÷+3.4).

Presence of two genetically different groups among the studied zircon, especially young magmatic grains, which origin is straightly connected to the basaltic flows formation, may indicate long-lasted evolution of MAR gabbroids and the scenario that the studied gabbro-peridotites are older than Mesozoic opening of the Atlantic Ocean should not be excluded.