Multiple crustal growth and recycling processes inferred from U-Pb and Lu-Hf on zircons – Evidence from the Limpopo Belt, South Africa

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The Limpopo Belt (LB) in southern Africa represents a unique example to study multiple crust-formation, -differentiation and -recycling processes in the late Archean and early Proterozoic. Magmatic events are documented at 3.2 Ga (e.g. the Sand River area) as well as at 2.6 Ga and at 2.0 Ga ([1] and references therein). The investigation of the 2.6 Ga magmatic event, which is documented all over the LB, presents a major clue to study the evolution of Archean TTG crust during subsequent magmatic activity.

The present study approaches the issue by the isotopical and geochronological study of zircons in combination with the geochemical investigation of the whole rocks.

U-Pb zircon ages as well as Lu-Hf isotopes were determined by LA-ICP(MC)-MS spot analyses on 7 samples of a suite of granitic to granodioritic and minor trondhjemitic rocks from the Regina Pluton, which is located ca. 100 km west of Musina in the Central Zone of the LB. Most samples show an identical U-Pb age of ~2.65 Ga, which is considered as the intrusion age of the pluton.

The interpretation of the Hf isotope data of the studied zircons and the rare earth and trace element geochemistry of the whole rocks leads to two different models concerning the processes finally leading to the formation of the Regina Pluton.

First, the studied plutonic rocks might represent a mixture between a juvenile, depleted-mantle derived magma and Paleoarchean crust-derived material. Second, the Regina Pluton might be the result of a pure crust fractionation process taking place at 2.65 Ga, caused by partial melting of 3.28 Ga old Sand River gneiss material.

The different models have major implications on the present knowledge we have of the assembly of the Limpopo Belt and the mechanisms leading to crust formation and –recycling in the early history of the Earth.

[1] Zeh *et al.* (2007) *J. Petrol.* **48**, 1605-1639.

Experimental analysis of Arsenic mobility in iron and sulfate reducing environments

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Stimulating formation of sulfide minerals in aquifers may be useful for remediating arsenic contamination. Our findings, however, suggest that mackinawite and pure arsenic-sulfide minerals such as orpiment do not provide efficient pathways for arsenic precipitation. In semi-continuous flow bioreactor experiments inoculated with natural microbial communities, we approximated a flow rate of about 28 $mL\cdot day^{-1}$ with medium containing 0.80 mM acetate and 7 μM arsenic as arsenate. We examined arsenic mobility in a system containing (1) iron reducing activity, (2) sulfate reducing activity, and (3) iron and sulfate reducing activity. All of the reactors also hosted arsenic reducing activity, which reduced 70 to 90% of the arsenic flowing into the reactors to arsenite. In the iron reducing system, ferrous iron content quickly increased to 200 μM and then, at about 125 days into the experiment, started to decrease to 50 μM as methane accumulated. Arsenic concentration in the iron reducing system slowly approached the level in the inlet medium as adsorption sites were eliminated. In the sulfate reducing system, sulfide content increased quickly to about 0.4 mM where it remained for the duration of the experiment. No arsenic-sulfide minerals formed and arsenic concentration equaled inlet levels throughout the experiment. In the iron and sulfate reducing system, sulfide was undetectable and ferrous iron levels increased to about 130 μM over the first 80 days of the experiment and then slowly decreased to about 25 μM. Arsenic content ranged highest in this reactor (>7 μM) despite formation of over 6 mM mackinawite by the end of the experiment. FEG-TEM analyses show that the mackinawite contained less than 0.1 wt % arsenic. Arsenic content increased more rapidly in this reactor than in the iron reducing system because removal of ferrous iron by mackinawite increased the rate at which iron reduction could occur. These results indicate, albeit indirectly, that pyrite, rather than mackinawite, may be the primary sulfide-mineral sink for arsenic in groundwater where microbial sulfate reduction limits arsenic contamination.