Origin, fate and transport of Chromium(VI) in Oropos, Greece

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A methodology that was comprised of field surveys of groundwater, surface water and soils, laboratory process experiments and hydrologic and geochemical modeling was used to identify the origin (anthropogenic vs geogenic sources), fate and transport of hexavalent chromium in tertiary and quartenary deposits of oropos plain in central-eastern Greece. More than 80 surface and groundwater samples and 33 soil samples were collected in 3 field campaigns during 2008 in order to characterize the spatial and temporal variability of chromium contamination. All soil samples were analyzed for total metal content and selected samples were used in batch-equilibrium, batch kinetic and column experiments in order to identify and characterize the sorption and release mechanisms of chromium with the soils. Modeling studies were conducted at the laboratory scale and the field scale. The groundwater modeling code PTC was used to simulate the fate and transport at the field scale and the geochemical code PHREEQCI the laboratory processes.

Results

The evaluation of aqueous and soil geochemical information revealed that the hexavalent chromium was of anthropogenic and geogenic origin. The anthropogenic component was originated from the industrial area of Oinophyta which is located up-gradient. Average concetrations of Cr(VI) in the river was 60 μg/L. In addition, spectroscopic analysis revealed that the soils originate from seprentine (ultra basic) dissolution. Groundwater wells were categorized (figure 1) according to Cr(VI) content. Group III were the anthropogenically impacted wells with mean Cr(VI) concentrations of 56 ±16 μg/L. Group II were impacted by geogenic origin with a mean concentration of 21±9 μg/L. Similar situations have been reported in many parts of the world. Soils exhibited high retardation of Cr(VI) and further capacity for accumulation. Hydrologic and geochemical modeling simulated the field and laboratory data.

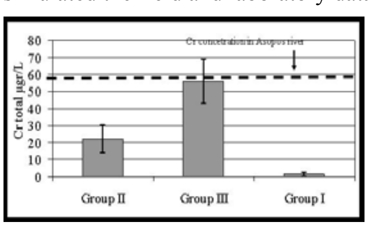

Figure 1. Three groups of wells according to Cr concentration in groundwater. CrIV was the dominant specie.

Evolution and stabilization of a juvenile crust: Zircon U-Pb and Hf isotopic perspectives from the northern Arabian-Nubian Shield

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The Arabian-Nubian Shield (ANS) is a major example of a juvenile continental crust. Its rock inventory exposed in the Elat massif (southern Israel) spans all ANS evolution stages. U-Pb dating of detrital zircons from the oldest metasediments indicates that island-arc activity occurred at ca. 900-750 Ma. These zircons display a wide range of $\varepsilon Hf_{(t)}$ values, from the expected Neoproterozoic depleted mantle value, ~14 ε units, down to less radiogenic values of ~5 ε units. This indicates that the newly formed arcs recycled a component of an older continental origin. It is thus difficult to envisage the earliest arc igneous phase as entirely intraoceanic. A swarm of (now schistose) dikes penetrated at ~700 Ma, in the course of an otherwise igneous tranquility. Zircons from one of these dikes yielded relatively elevated $\varepsilon Hf_{(t)}$ values of ~12 ε units, which plot within the depleted mantle range. Crustal thickening along the entire East African Orogen was followed by late to post-tectonic calc-alkaline magmatism dated in the Elat massif at ca. 670-600 Ma. Subordinate, shallower alkaline magmatism was dated at ca, 610-590 Ma. Some of these later intrusions carry inherited pre-Neoproterozoic zircons of various ages between 2.5 and 1 Ga, indicating the presence of older crustal sources at the subsurface. Zircon $\varepsilon Hf_{(t)}$ values from the calc-alkaline and alkaline granitoids resembles, albeit slightly lower, those of the island-arc magmas, ca. 10-4 ε units, suggesting that the calc-alkaline/alkaline magmas were produced chiefly by extensive remelting of the older island-arc crust. As a whole, our study indicate that overall ANS juvenile crustal evolution lasted ca. 300 myr, but the most significant episode of mantle extraction took place almost exclusively during the earliest 150 myr of island-arc magmatism. Cratonization of the shield via widespread calc-alkaline batholitic intrusions, resulted from large-scale differentiation of the island-arc crust but lagged some 100-250 myr after initial extraction from the mantle.