The impact of subducting sediment on the HFSE budget of arc-related igneous rocks, Banda arc, Indonesia

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Subduction processes and associated arc volcanism play a key role in determining the chemical composition of continental crust. The contribution of subducting sediment to arc magmatism is still poorly constrained but potentially accounts to a significant extend for the HFSE budget of arc-related igneous rocks. The Banda arc in Indonesia has a unique geologic setting that allows HFSE behaviour in a subduction zone to be studied. The amount of subducting sediment being dumped into the subduction regime increases from NE-SW from 0.1 to 5 wt.% [1]. Samples collected along the arc front, well defined for their Nd-Pb-Sr-O isotopes and trace elements [2,3], are analyzed for their Hf isotopes and HFS element concentrations. Hafnium isotope data, ranging from –3.4 εHf to +13.0 εHf, and negative-correlated Hf-O isotope co-variations support the increase in sedimentary influx. The Hf isotope data are systematically decoupled from Nd isotopes, most likely due to partially enhanced fluid-melt mobility of LREE. Zr/Hf exhibit no variation with Th/Yb, which points to no significant decoupling of Zr from Hf with elevated amounts of subducting sediment. In contrast, Nb/Yb is significantly elevated with Th/Yb, pointing to enhanced Nb concentrations with increasing sediment subduction. High precision Nb/Ta data will be used to monitor variations in HFSE caused by sediment subduction and potential residual mineral phases.

References:

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Tracing Earth's first crust with Hf isotopes in zircons from the Narryer Gneiss Complex, Australia

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Witnesses of the infant crust on Earth are rare because no rocks that formed in the fist 500 Myrs are preserved and the only remnants of Hadean material are zircon crystals that survived reworking of their host rocks. In order to unravel the evolution of the Earth's oldest crust, Archean and Hadean detrital zircons from the Mt. Narryer Gneiss Complex were investigated for their U-Pb and Lu-Hf isotope systematics. The U-Pb systematics of six zircons from the Meeberrie Gneiss define an upper concordia intercept age of 3300 Ma and two lower intercepts at ~ 500 Ma and 700 Ma, which we interpret as the formation ages of the gneiss protolith and later thermal overprints, respectively. Corresponding εHf_T range from -8.6 to -11.2. Eight zircons from a metasediment from Mt. Narryer show ages from 3.2 to 4.2 Ga with corresponding eps Hf of +3.4 to -7.1. Two zircons from a metasediment from Jack Hills are 4200 Ma old and have εHf_T of -0.5 and -2.9. The age distribution and corresponding initial Hf isotopes indicate similar source regions for the Mt. Narryer metasediments and Meeberrie Gneiss. Older (>3.8 old) grains from Jack Hills and the Mt. Narryer metasediments origin from sources that already formed in the Hadean.. The combination of these new data with published zircon data, indicate that crustal growth during the first 500 Myrs occurred more or less continuously by formation of small crustal domains.