Mass-independant fractionationation during TIMS measurements: Evidence of nuclear shift effect?

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"Abnormal fractionation" of the ^{207}Pb isotope relatively to the mass dependent fractionation between ^{204}Pb, ^{206}Pb and ^{208}Pb has been detected during long high precision Pb isotope measurements by thermal ionization mass spectrometry (TIMS) of the standard SRM-981 (Thirwall, 2000; Doucelance and Manhès, 2001).

Zn, Cd and Pb isotope measurements with TIMS (Manhès and Göpel, 2003) revealed that the odd isotopes (^{67}Zn, ^{207}Pb, ^{111}Cd-^{113}Cd) were affected during extended runs by a mass-independent fractionation in addition to the purely mass-dependent fractionation shown by the even isotopes, leading to an accumulated depletion of the odd isotopes. TIMS Pb isotopic measurements of the standard SRM-981 spiked with ^{202}Pb and ^{205}Pb (Amelin, Davis and Davis, 2005) confirmed this effect. Both studies suggested the nuclear spin carried by the odd nuclides as responsible for these mass independent fractionations.

Recently, Amelin, Davis and Davis (2006) suggested that these observed accumulated depletion of odd isotopes relatively to the even isotopes result from a larger volatility of odd isotopes due to the differences in the shape of the nuclei. This idea results from a new interpretation of mass independent isotope fractionationation observed in FUN inclusions of Allende meteorite (Fujii, Moynier and Albarède, 2006) implying the nuclear field shift (Bigeleisen, 1996). The nuclear field shift effect is evocated for the origin of mass-independent fractionation in chemical exchange reactions (Biegeleisen, 1996).

The aim of our study is to identify the process that induces the mass independant fractionation during the thermal ionization processes. Our experiments of the thermal ionization of Pb and Cd suggest that the evocated difference in volatility between odd and even isotopes is not the key process but the change in oxydation states of the elements inside the glass beads.

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Geochemical characteristics of adakites from different greenstone belts of Eastern Dharwar Craton, India – Implications on subducted slab-mantle wedge interaction

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The continental crust in the Dharwar Craton of Peninsular India has evolved through terrain accretion and amalgamation of oceanic plateaus and island arcs. The adakites identified from Sandur, Gadwal and Kushtagi greenstone belts exhibit geochemical variation reflecting on their petrogenesis. Adakites of Gadwal belt have SiO_2 = 56 – 72 wt.%, Al_2O_3 = 11 – 17 wt.%, high MgO (0.67 – 3.9 wt.%), Na_2O (2.2 – 4.9 wt.%), K_2O (0.57 – 1.9 wt.%), low Mg# (35 – 55), Ni (0.7 – 11 ppm), Cr (1.8 – 27 ppm), Sr (142 – 420 ppm), Y (10.3 – 19 ppm), Yb (0.79 – 1.5 ppm) whilst Sandur adakites have comparatively high SiO_2 (75 – 78 wt%), low Al_2O_3 (12 – 13 wt%), MgO (0.15 – 0.24 wt%), high Mg# (58 – 85), Na_2O (4.7 – 7.2 wt%), K_2O (1.01 – 2.05 wt%), Ni (1.3 – 41 ppm), Cr (9.6 – 292 ppm), low Sr (175 – 237 ppm), Y (4.5 – 6.9 ppm), Yb (9 0.3 – 0.5 ppm). The Rare Earth Element (REE) patterns of Sandur adakites are highly fractionated compared to Gadwal (La/Yb = 43 – 71 and 9 – 29, respectively). Sr/Y ratio in Gadwal adakites is depleted (12 – 27) compared to Sandur adakites (26 – 46) whereas the Zr/Sm ratio of Gadwal adakites is 32 – 58, slightly higher than Sandur adakites. Phanerozoic adakites studied from different parts of the world along with Archaean adakites (from Abitibi) have been interpreted as melts derived from the subducted slab. The geochemical characteristics of slab melts is modified by their interaction with mantle wedge during its ascent and thereof the magmas derived from the partial melting of metasomatized wedge will reflect the composition of slab derived fluids/melts. The overall geochemical characteristics of these adakites and their occurrence with arc basalts, boninites, NEB and high Mg-andesites signify a transition from slab dehydration-wedge melting to slab melting-wedge hybridization and these new observations of adakite geochemistry in different greenstone belts endorse the emergence of complex arc magmatism in Neoarchaean terranes.