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Terrestrial Accretion History as Recorded in Element and Isotope Abundances of Bulk Silicate Earth

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The element abundances in Bulk Silicate Earth (BSE) are the result of accretion of material with different chemical depletion histories and differentiation steps during the assembly of the Earth. The element abundances in BSE can be modelled as a mixture of three components with different degrees of volatile-element depletions. These components are constrained through different element groups with relative chondritic abundances in BSE. These groups are: a) refractory lithophile elements, b) moderately volatile lithophile elements, c) highly siderophile elements. Component A was strongly depleted in volatile elements and had a low O-fugacity. This component is not represented by any known meteorite group but its isotope composition has strong similarities to the non-carbonaceous chondrite reservoir. Component B was less depleted in volatile elements and more oxidized than component A. Its isotope signatures indicate a strong affinity to the carbonaceous chondrite reservoir. Component C has strong similarities to carbonaceous chondrites (CM-chondrite). Mixing the three components in the ratio 9:1:0.3, and considering element fractionation by core formation, reproduces the element pattern of BSE. Thus the BSE composition shows a record of mixing of material originating from very different regions of the Solar System. In this model component A corresponds to proto-Earth, component B to Theia and component C is the late veneer. ^{53}Cr model ages constrain the time of element depletion in component A to the first 3 Myr of the Solar System. The major volatile element contribution to Earth derives from component B. Modelling the U-Pb and Rb-Sr isotope systematics of Earth yields an age of ca. 4.50 Ga for the giant impact that resulted in the Earth-Moon system.