

Origin of Earth's volatile elements: Constraints from Rb isotopes

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Compared to the composition of C1-meteorites the Earth is strongly depleted in volatile elements. This depletion may be due to incomplete condensation or volatile loss caused by impact heating during the early stages of the planet formation. The elemental depletion correlates roughly with the half-condensation temperatures of the elements. This general depletion trend for the volatile element abundances in bulk silicate Earth (BSE) is modified due to core formation which further fractionated elements based on their siderophile and/or chalcophile behavior. The combined cosmochemical and geochemical effects result in the irregular trends observed in the abundances of the volatile elements in BSE. In order to separate the different depletion processes that affected the final composition of BSE we compare the abundances of Rb and Pb and their isotope compositions in terrestrial samples and meteorites. In order to evaluate the variability of Rb isotopes in different solar system materials the Rb-isotope compositions of 17 primitive meteorites and terrestrial samples was analysed by MC-ICP-MS with Zr as an internal standard. This technique results in a reproducibility of $\pm 0.2\%$ for $^{87}\text{Rb}/^{85}\text{Rb}$. The observed variation of the Rb-isotopes in all materials studied is less than 2%. The variation does not correlate with the Rb elemental abundances. The unfractionated Rb-isotopes of the Earth imply that the volatile element depletion is not due to evaporation or incomplete condensation alone but requires at least a two step process. A more realistic model is that the Earth consists primarily of a large component of essentially volatile free material that was later mixed with a component that was not depleted in volatile elements. In this model the Rb-isotope composition of the mixture is dominated by the isotope composition of the undepleted component. Mass balancing with a 90% depleted Proto-Earth and gain of 10% C1 material can account for the Rb isotope distribution and abundance in the present day BSE. If Pb behaved approximately like Rb, as is suggested by its similar half condensation temperature, BSE requires an additional Pb depletion event to account for its observed U/Pb and Pb-isotope systematics. Comparison of Rb abundances and isotopes with Pb abundances and isotopes implies that the Pb-depletion in the BSE was not solely due to core formation but most of the Pb was already missing from the Earth prior to final core mantle equilibration.

Simulating experiments on gas generation of coal under different fluid pressure

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It is still a controversy whether fluid pressure has a retardation for the hydrocarbon generation of source rock or not [1-2]. 4 groups experiments of gas generation of coal were conducted under different fluid pressure (25Mpa, 50Mpa, 75Mpa and 100Mpa) and temperature (300°C-650°C) in gold tube closed system. The maximum amount of total hydrocarbon gas are 102.32ml/g. coal, 95.63ml/g. coal, 122.26ml/g. coal and 124.56 ml/g. coal under 25Mpa, 50Mpa, 75Mpa and 100Mpa, respectively. So, fluid pressure action on gas generation of coal is not acceleration or retardation simply, but retardation in a relatively low scope of fluid pressure, and acceleration for gas generation of coal with fluid pressure increasing. The amount variation of methane generated by coal with fluid pressure increasing is consistent with that of total gases, but the volume variations of other gas components (such as H₂, H₂S, CO₂) have great difference, this indicate the influences of fluid pressure on these gases formation are different.

There is no explicit correlation between the value of $\delta^{13}\text{C}_1$ and the fluid pressure below 430°C, the value of $\delta^{13}\text{C}_1$ becomes from light to heavy first, then to light with the fluid pressure increasing in main period of gas generation (above 470°C) in all 4 groups experiments. The more of gas generating from coal is, the lower of H/C value of coal residue is. The R₀ value of pyrolysis residue under 50MPa is lower than that under others fluid pressure in 470°C-575°C, in a point of other range temperature, there is no measurable difference of residue R₀ in 4 group experiments

[1] Dalla Torre M. *et al.* (1997) *Org Geochem* **61**, 2921–2928.

[2] Wei Tao *et al.* (2010) *Fuel* **89**, 3590–3597.