# When Paradigms Collide: Volatiles in Earth's Mantle

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The combination of new sample resources, such as volcanic carbon dioxide deep gas fields, in conjunction with the availability of multi-collector mass spectrometery in the noble gas community, has recently led to a significant advance in determining the noble gas composition in the Earth's mantle.

High precision Ne, Kr and Xe isotopes now resolve the question of whether the Earth's mantle aquired its primordial volatile content from the equilibration of a magma ocean with a solar nebula atmosphere or whether these volatiles were brought to the Earth as trapped constituents in meteorites. This distinction is fundamental in determining the processes controlling planetary volatile aquisition. Comparison of these mantle components with the modern atmosphere allows us to form a view on the role the mantle, and by proxy the accretionary sources providing the mantle volatiles, has played in forming the early atmosphere. Data points to a yet later volatile addition to the Earth to form the atmosphere.

It has been speculated that, for species as incompatible as the noble gases, there is an effective subduction barrier preventing these gases from contributing significantly to the convecting mantle system. On the contrary, the new data suggests that there has been a significant atmosphere-overprint of the convecting mantle accretionary volatiles to provide a new and sensitive tool for tracking associated volatile recycling within the dynamic deep Earth.

Heavy halogen (Cl, Br, I) abundance can be determined in samples through neutron irradiation and analysis of the resulting unique noble gas isotopes to provide data that complements the noble gases [1]. These provide a unique insight into the mechanisms that control halogen composition of evolving planetary bodies [2]; the controlls on the distribution of halogens within subducting material [3]; and, with new partitioning behaviour of halogens during melting [4], show the processes that determine whether and how these exhibit on return to the Earth's surface [5]. Together the noble gas and halogens are providing the observational foundation for building a new picture of Earth volatile acquisition, distribution and evolution.

[1] Ruzie *et al*, 8d Mon, Broadley *et al*, 8d Mon [2] Clay *et al*, 02b Thurs [3] Chavrit *et al*, 05d, Wed [4] Joachim *et al*, 05e Tues, 08e Tues [5] Broadley *et al*, 04b Fri, Chavrit *et al*, 08a Mon