

## Isotopically light (Solar?) nitrogen associated with the planetary noble gas carrier (Q)

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The nature of the planetary noble gas carrier (Q) has remained an intriguing cosmochemical puzzle for decades. Q can be significantly enriched by dissolving all meteoritic silicate minerals to leave behind only carbonaceous material and oxides. However, even after that, the abundance of Q in the residue is much less than 1%. This is the main reason why Q is so difficult to identify. Therefore, Q is characterised indirectly by its properties, such as its susceptibility to oxidation or its resistance to parent body metamorphism compared to macromolecular materials as well as by the noble gas components it contains. Such observations suggest that Q has been formed very early in the Solar System, or may even predate its formation.

Our analyses of a number of CR meteorites using our multi-element isotope analyser, Finesse, in combination with stepped combustion, has revealed a new property of Q – its separation from most of macromolecular carbon and nitrogen. In CR2 and CR3 petrological groups, but not in CR1s, the Q noble gases, are released in a narrow range at a high temperature (~1100°C). It appears that Q somehow becomes isolated within the matrix from direct contact with oxygen gas during stepped combustion. Only when the matrix opens up does oxygen react with Q (oxidising it almost instantly). Since almost no macromolecular C and N remains by the time of Q oxidation, the Q nitrogen dominates the release at these temperatures. And, as such, its isotopic composition is revealed. The lowest measured  $\delta^{15}\text{N}$  associated with the noble gas release at the high temperatures is -140‰. And this is only the upper limit since a certain amounts of other (isotopically heavier) N components are also present along with Q nitrogen. We believe that Q nitrogen is likely to have  $\delta^{15}\text{N}$  similar to solar composition (-380‰) determined by the Genesis mission. The presence of solar N in Q is also consistent with its He isotopic composition corresponding to pre-deuterium burning era of the early Solar System.

## On the importance of ternary alkaline earth carbonate complexes of uranium(VI) in natural waters: a round-robin modeling test

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The availability of uranium in natural waters is governed by many processes and interactions with chemical compounds. At equilibrium the predominant soluble and solid forms of uranium can be estimated using thermodynamic data and aqueous geochemical speciation codes. The quality of calculations is mainly related to the quality and completeness of the entry data. Within the working group “Speciation” of the CETAMA a round-robin modeling exercise was conducted about the U(VI) speciation in waters of known compositions. The objectives were: i) to test thermodynamic data bases; ii) to compare the modelers’ methods in selecting data; and iii) to evaluate the effect of inorganic species on the U(VI) speciation and solubility.

A recent experimental study on the speciation of uranium in drinking waters have shown that calcium uranium carbonate complexes play an important role [1]. The modeling exercise was build on the basis of water compositions of two of these samples. Other water compositions were derived from these in order to better check U(VI) speciation changes with the bicarbonate content, the saline content and  $[\text{Ca}^{2+}]$  and  $[\text{Mg}^{2+}]$ . The participants of this exercise were asked to provide the distribution of soluble uranium species and evaluate the uranium solubility-controlling solid phase for each water.

The main outcome is on the importance of alkaline earth carbonate ternary complexes such as  $\text{Ca}_2\text{UO}_2(\text{CO}_3)_3(\text{aq})$ ,  $\text{CaUO}_2(\text{CO}_3)_3^{2-}$ , and  $\text{MgUO}_2(\text{CO}_3)_3^{2-}$ . These species were reported in recent publications [2], but rarely included in available data bases. As a consequence it emphasizes the necessity of continuous enrichment of data bases with a consistent approach to avoid bias. Moreover, the amount of uranium in solution could be calculated considering various solubility-controlling phases though such estimations definitely requires the expertise of the geochemist.

[1] Prat, Vercouter, Ansoborlo, Fichet, Perret, Kurttio, Salonen (2009), *Environ. Sci. Technol.* 43, 3941–3946. [2] Dong, Brooks (2008), *Environ. Sci. Technol.*, 42, 1979–1983.