6.2.P02

The new geochemical classification of the elements and a complex model of the Earth's geochemical evolution

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V. M. Goldschmidt [1] classified the elements forming cations according ionic potential (IP) into 3 geochemical groups: (1) soluble cations, (2) elements of hydrolizates and (3) complex soluble anions. Dangic [2] proposed a more complex classification according IP of both anions and cations into 7 groups (Table 1), with IP: 1) <-1.5; 2) -1.5 to -1.2; 3) -1.2 to -0.8; 4) -0.8 to 0; 5) 0-3; 6) 3-12; and 7) >12.

Table 1. Dangic's geochemical classification of the elements.

1	Anions of extremly a.s.[1]	N^{3-}, P^{3-}, C^{4-}, S^{-4}, Pb^{4-}
2	Anions of strongly a.s.	As^{3-}, Sb^{3-}, Bi^{3-}, Sn^{4-}, Ge^{4-}
3	Anions of reduzates	S^{2-}, Se^{2-}, Te^{2-}
4	Soluble anions	F^-, Cl^-, Br^-, J^-
5	Soluble cations	K^+,Na^+,Li^+,Ca^{2+},Mg^{2+},Fe^{2+}...
6	Elements of hydrolizates	Al^{3+}, Fe^{3+}, Cr^{3+}, Mn^{4+}, Th^{4+}.
7	Soluble complex anions	B^{3+}, C^{4+}, P^{5+}, N^{5+}, S^{6+}, Se^{6+}

[1]- a.s= anoxic systems

This classification is used for establishing a model of geochemical evolution of the Earth, with 4 main stages:
(1) Evolution of the homogenous primordial Earth (4.5 b.y. ago) into 3 geospheres: liquid iron core and silicate mantle and a gasous (H_2-rich) atmosphere. The core and the atmosphere were extremely anoxic and contain also N^{3-}, P^{3-}, C^{4-}, and other anions of the group 1. The anions of the groups 2 and 3 dispersed around the core-mantle boundary. **(2)** Formation of the crust (4.2 b.y.ago), the early hydrosphere and start of sedimentary processes. Due to anoxic atmosphere/ hydrosphere, oceans were enriched with anions of the groups 3 and 4 and cations of the group 5 (including Fe^{2+}); weathering crusts were enriched in Al but depleted in Fe. Marine sediments contained Fe^{2+}-minerals. **(3)** Anoxic atmosphere and hydrosphere changed into the oxic ones. Oceans appear to be enriched in anions of the groups 4 and 5 and complex anions- the group 7 ($SO_4^{=}$, etc.) but depleted in Fe; weathering crusts appear to be enriched in both Al and Fe (Fe^{3+}), Mn, etc. **(4)** Biosphere formation– appearing and development of the life: organisms at/near the Earth's surface handled by their genetic programs use energy, create geochemical systems contrasting to the environment, select elements, synthetize and preserve organic molecules and cells. They create reduced conditions to form some anions of the group 1 (C^{4-}, N^{3-},..) to combain them with H^+, O^2-, etc. in organic matter.. They used also several elements of the groups 4, 5, and 7.

References

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6.2.P03

Xenon isotopes in ancient zircons and the Pu/U ratio of the early Earth

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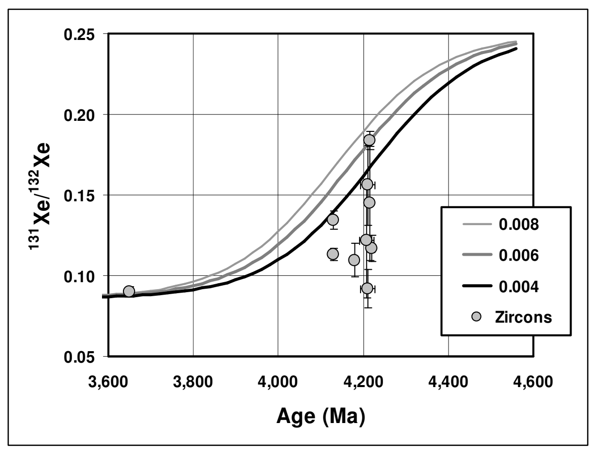
We have previously reported the presence of xenon from the fission of now extinct ^{244}Pu in individual 4.13Ga to 4.18Ga zircons from Western Australia[1]. This discovery offers the possibility of a direct determination of the Pu/U ratio of the early Earth, an important parameter in models of nucleosynthesis, mantle and atmosphere evolution, and cosmochronology. Figure 1 illustrates how the ^{131}Xe/^{136}Xe ratio varies with closure age for initial Pu/U ratios (calculated at 4.56Ga) ranging from 0.004 to 0.008, which covers the range of estimates based on meteorite analyses.



Superimposed on the figure are the ^{131}Xe/^{136}Xe ratios for our earlier analyses of a suite of three ~4.13Ga zircons, and a recent set of data for three ~4.22Ga zircons. The data from both sets of analyses shows a spread in ^{131}Xe/^{136}Xe (and the correlated ^{132}Xe/^{136}Xe ratios) corresponding to initial Pu/U ratios from essentially zero to 0.0035 ± 0.0005 (4.13Ga suite) and 0.0061 ± 0.0010 (4.22Ga suite). The variable ratios between and within zircons could result from loss of Xe after 4.0 Ga or represent U-Pu fractionation, or a combination of the two. To evaluate these options, future eperiments will search for correlations with REE patterns, oxygen isotopes, and the degree of U-Pb concordance, and investigate the thermal release characteristics of the xenon.

References

[1] Turner G., Harrison T.M., Holland G., Gilmour J.D. and Moszsis S.J. (2003) *Meteoritics Planet. Sci.*