Neo-plumbotectonics

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Francis Birch's almost five decade old proposed relationship between continental heat flow and heat production, which established that the heat producing elements U, Th, and K concentrate in the uppermost ~10 km of the crust, where they are slowly removed by erosion, revolutionized crustal geodynamics and has since been a cornerstone for understanding continental dynamics and evolution [1]. It provided an instant explanation for why heat production is smaller in the Precambrian crust with respect to its modern counterparts and why rheology varies with the age of continental provinces. U and Th are remarkable proxies for tectonic mixing, uplift, and erosion. Yet, although crustal U and Th segregation is well documented, U, the largest contributor to heat production, is massively leached by groundwater, and the mechanisms underlying crustal differentiation of U and Th are still unclear. Birch's hypothesis hence requires more rigorous testing. Scientific breakthroughs often come from our ability to apply new analytical techniques and enhanced capabilities to long-standing problems. Using the relative abundances of Pb isotopes produced by the radioactive decay of U and Th, I will revisit Zartmann's concept of Plumbotectonics [2], a term coined over three decades ago to explain Pb isotope systematics among the major terrestrial reservoirs, but here using a modern approach and perspective. I will address the issue of U and Th in the crust, as well as its broad-ranging implications for crustal geodynamics and other fields, such as environmental sciences and archeology to elucidate possible Pb contamination as well as trace the development of early manufacturing and commerce in sediment cores from ancient harbors and in old silver coins. The idea that Pb isotopes can be used to interpret regional geodynamics and geochemistry, which can then lead to a clearer perception of geotectonic processes at the continent scale, was unique and exciting. Plumbotectonics, however, was before its time, as the analytical techniques and capabilities were not able to fulfill its early promise. Now, with a new ~7000 entry Pb isotope database for Europe, which, with its large amount of data, provides proof of concept and heralds application to other continents, and the geologically informed parameters of Pb model ages (T_{mod}), μ ($^{238}U/^{204}Pb$), and κ ($^{232}Th/^{238}U$), I will demonstrate the value of Pb isotopes as large-scale proxies of crustal differentiation and tectonics, and as a useful provenance tool in archeometry and geoarcheology.

[1] Jaupart C. & Mareschal J.C. in *Treatise on Geochemistry* (2012) [2] Zartman R. & Doe B. *Tectonophys.* **75** (1981) 135.