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The importance of PetDB and GeoRoc in mantle geochemistry

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Early in our careers in the 1980s, anyone generating data syntheses required spending countless hours typing published ocean island basalt (OIB) and mid-ocean ridge basalt (MORB) data into computers. At the Max Planck Institute for Chemistry in Mainz, Germany, with Al Hofmann and Kerstin Lehnert, among many others, it was recognized that we needed a means to easily access the published data, and first data spreadsheets were created internally for our Division. In the mid-1990s GeoRoc in Mainz and PetDB at Lamont were founded to make OIB and MORB data accessible to everyone. These databases had a transformative effects on geochemistry. By 2005, when we were working on the interpretation of a set of helium isotope data, we were actually able to put together the global data with the help of the databases within a reasonable time frame. Class and Goldstein (2005) grouped data from individual hotspots into four groups based on their extreme $^{3}He/^{4}He$ isotope ratios relative to MORB, and compared them with other geochemical characteristics. This approach overcame the scarcity of helium isotope data and the "decoupling" of helium from other isotope systems. A fundamental global observation emerged, that the groups are systematically arranged in "Sr-Nd-Pb isotopic space", with the 'high $^{3}He/^{4}He$' group most MORB-like, while the increasingly radiogenic $^{3}He/^{4}He$ groups showed increasingly enriched Sr-Nd-Pb isotopic compositions. Because ^{4}He is generated by the radioactive decay of U and Th, this implies a direct relationship between $^{3}He/^{4}He$ and either the plume source formation age or their Th and U content. Since OIB show a range of Th contents over three orders of magnitude, much larger than effects of melting and fractionation, and high $^{3}He/^{4}He$ sources showed low Th abundances, this demonstrated the importance of source enrichment/depletion over the source formation age. In celebration of GeoRoc and PetDB and with 20 years of additional OIB and MORB data, we will revisit these global systematics and their interpretation. Such global data synthesis are the foundation of all global models in mantle geochemistry and are only possible thanks to PetDB and GeoRoc.

Reference: Class and Goldstein, 2005, Nature 436 (7), 1107-1112