PLANETARY SCIENCE RESEARCH DISCOVERIES
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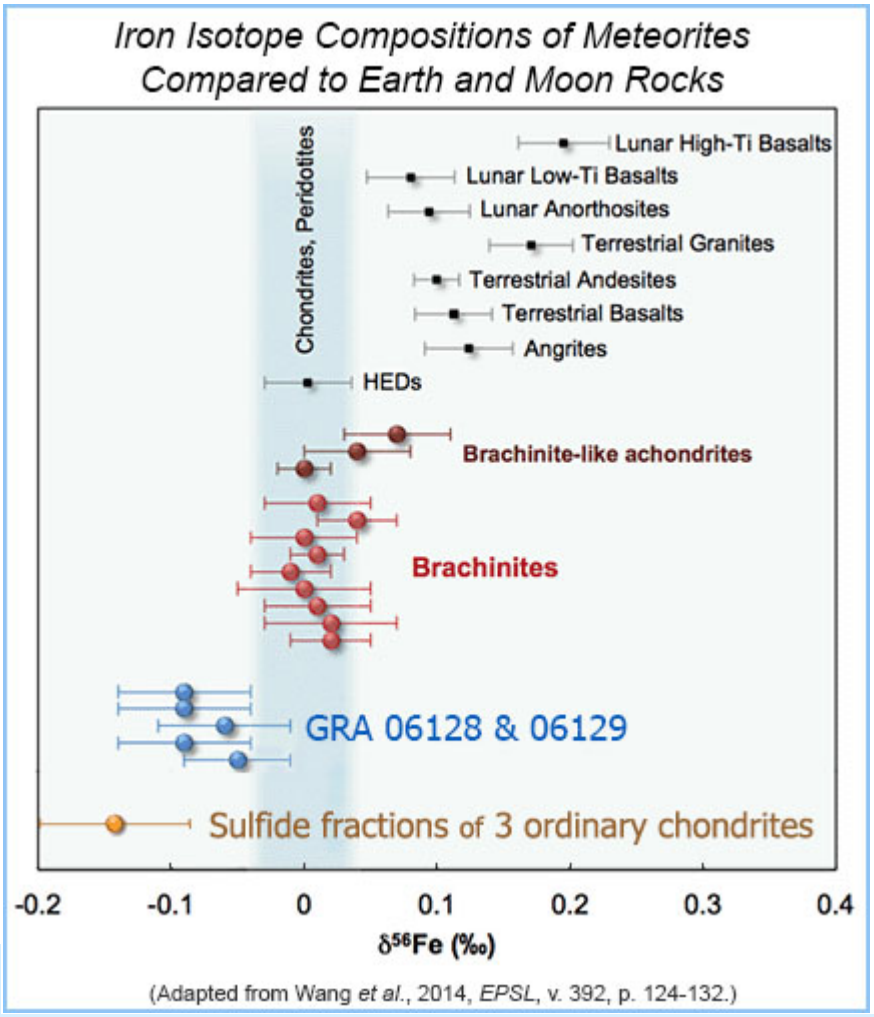
Felsic Crust Formation

Meteorites Graves Nunataks (GRA) 06128 and 06129 [***ANSMET Antarctic finds***] are two rare examples of felsic crust (containing >70 modal percent sodium-rich plagioclase) that formed early in Solar System history, in contrast to the more common mafic, basaltic crusts we associate with planetary embryos and asteroids.

Researchers are studying these meteorites to better understand early crust formation, especially the processes of low-to-moderate degree partial melting in a body not fully ***differentiated***. Kun Wang (Washington University in St. Louis), James Day (Scripps Institution of Oceanography), Randy Korotev (Washington University in St. Louis), Ryan Zeigler (NASA Johnson Space Center), and Frédéric Moynier (Washington University in St. Louis and Université Paris Diderot) analyzed iron isotope data of the paired achondrites GRA 06128 and 06129, six brachinites, three brachinite-like achondrites, and phase separates (metal, silicate, and sulfide) of three ordinary chondrites (see summary plot). Previous work has shown the isotopes of iron ***fractionate*** during magmatic differentiation processes such as partial melting.



This plot shows negative δ^{56}Fe isotope compositions reported for meteorites GRA 06128 and 06129 (blue data points, the average of these points is -0.08 ± 0.06‰) and for sulfide fractions of three ordinary chondrites (the gold data point is the average value of -0.14‰). Data from Wang and coauthors as well as previously published work by others; see reference for full details.

Not only are meteorites GRA 06128 and 06129 the only known extraterrestrial samples of felsic crustal rocks, the analyses by Wang and colleagues show these rocks also have unusual, isotopically light iron isotope compositions (negative values of δ^{56}Fe). In contrast, all other planetary crust materials, including Earth's felsic crustal rocks (granites and andesites on the plot), have heavy iron isotope enrichments (positive values of δ^{56}Fe). Peridotites, which represent Earth's mantle rocks, and chondrites plot in the blue-shaded area about 0.0 δ^{56}Fe ‰. Wang and coauthors also report enrichment in lighter iron isotopes (average of -0.14 δ^{56}Fe ‰) for sulfide fractions of three ordinary

chondrites, which leads them to suggest a sulfide control on the enrichment of light iron isotopes in GRA 06128 and 06129. A formation scenario they suggest is preferential melting of sulfide phases in chondritic planetesimals to form the iron-sulfide-rich felsic melts by low-to-moderate degree partial melting before the start of higher-termperature basaltic melting.

See Reference:

· Wang, K., Day, J. M. D., Korotev, R. L., Zeigler, R. A., and Moynier, F. (2014) Iron Isotope Fractionation During Sulfide-rich Felsic Partial Melting in Early Planetesimals, *Earth and Planetary Science Letters,* v. 392, p. 124-132. doi: 10.1016/j.epsl.2014.02.022 [***NASA ADS entry***].

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