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Origin of volatile depletion in protoplanets inferred from Rb-Sr isotope systematics

Hans, U., Kleine, T.*, Bourdon, B., *Institut für Planetologie, Westfälische Wilhelms-Universität Münster, thorsten.kleine@wwu.de.

A strong depletion in moderately volatile elements is a characteristic feature of many planetary bodies in the inner solar system and either reflects a rapid accretion of planetesimals from an incompletely condensed solar nebula, or is the result of energetic collisions during planetary accretion. To better constrain the origin and timescales of this volatile depletion, we have precisely measured Sr isotopic compositions in angrites, eucrites and Ca-Al-rich inclusions (CAI). In agreement with earlier studies we find that angrites and eucrites have higher initial $^{87}Sr/^{86}Sr$ ratios than CAI, corresponding to model timescales for volatile loss of several millions of years. However, all the investigated CAI are characterized by elevated $^{84}Sr/^{86}Sr$ ratios compared to angrites and eucrites, most likely reflecting an excess of *r*-process Sr in the CAI. Once these nucleosynthetic Sr isotope anomalies are taken into account, no significant difference remains between the initial $^{87}Sr/^{86}Sr$ of CAI, angrites and eucrites. This implies that the angrite and eucrite parent bodies formed by rapid accretion (<1.5 Ma after CAI formation) of volatile-poor dust in an incompletely condensed solar nebula.

Cite abstract as:
Hans, U., Kleine, T., Bourdon, B. (2012) Origin of volatile depletion in protoplanets inferred from Rb-Sr isotope systematics. Paneth Kolloquium, Nördlingen (Germany), abstract URL: http://www.paneth.eu/PanethKolloquium/2012/0231.pdf (abstract #0231).