

Genesis of K-enriched felsic magmas: A collection of contrasting crustal connexions

JOHN D. CLEMENS

School of Earth Sciences & Geography, CEESR, Kingston
University, Penrhyn Rd, Kingston-upon Thames, Surrey
KT1 2EE, UK (j.clemens@kingston.ac.uk)

High-K calcalkaline granitic (s.l.) magmas are formed in late orogenic, post-orogenic and anorogenic settings. Proposed origins include; assimilation of crustal rocks by basaltic magmas, partial melting of the enriched mantle with fractionation, reactive assimilation of wall rocks by normal-K magmas, magma mixing, and melting of composite sources with interlayered pelites and amphibolites. Metabasaltic rocks are not suitable sources; nor are any experimentally studied metagreywackes, metatonalites or metadacites. High-K arc andesites and certain metaluminous Bt-Pl-Qtz gneisses could be suitable protoliths, so neither the protoliths nor the conditions in high-K magma genesis need to be special or complicated. Nevertheless, sometimes the main protoliths are not crustal, and the processes involved are very complex.

K-rich adakites occur over wide areas and lack either temporal or spatial association with subduction. They have all the geochemical attributes of typical subduction-related adakites except that $K_2O/Na_2O > 0.95$, over a broad range of SiO_2 (~ 58 to 74 wt%), so low-degree partial melting or fractionation are not viable origins. Isotopes indicate strong crustal involvement. Near-liquidus experiments were carried out on a typical K-adakite, at 2, 4 and 6 wt% H_2O , with the constraint that the assemblage should contain Grt but not Pl. This work showed that K-adakites were high- T (> 1075 °C), very hydrous magmas (~ 6 wt% H_2O) formed by fluid-absent partial melting of metatonalites, meta-andesites, and possibly potassic metabasalts at $P > 2$ GPa.

Felsic sanukitoids are Late Archæan, post-tectonic, K-rich, high-Mg rocks that have geochemical characteristics similar to both mantle- and crust-derived magmas. High- T (1200 °C?) melting of Phl peridotite could explain their peculiar chemistry. Near-liquidus experiments on a monzodiorite from Panozero produced Phl near the liquidus, confirming residual mica in the protolith. However, neither Ol nor Grt is present. Thus, the source may have been phlogopite clinopyroxenite, rather than peridotite, formed in a global enrichment event.

In conclusion, K-enriched, metaluminous, felsic magmas have a wide variety of origins. The K sometimes originates directly from a crustal protolith but is commonly from the enriched mantle, subduction-zone fluids being the ultimate source. Given the difficulty of forming the more mafic granitoids by crustal melting, we should take a fresh look at the mantle for the origin of many granitic series, not through direct derivation but through fractionation of enriched mafic magmas.

Identification of aromatic organic matter from comet 81P/Wild 2

SIMON J. CLEMETT¹, KEIKO NAKUMA-MESSENGER²,
DAVID S. MCKAY³ AND SCOTT A. SANDFORD⁴

¹ERC, Inc. / NASA JSC, JE-23, Houston, TX 77058
(simon.j.clemett@jsc.nasa.gov)

²Jacobs-Sverdrup / NASA JSC, JE-23, Houston, TX 77058
(keiko.nakamura-1@jsc.nasa.gov)

³NASA JSC, Mail Code JE-23, Houston, TX 77058
(david.s.mckay@jsc.nasa.gov)

⁴NASA Ames, MS 245-5, Moffett Field, CA 94305
(ssandford@mail.arc.nasa.gov)

Comets provide a unique perspective on the formation of the Solar System and provide a missing link to the progenitor dense molecular cloud from which it arose. Due both to their small size, and site of accretion in the outer reaches of the Solar System, comets have escaped large-scale differentiation and thermal alteration and so may retain much of their original presolar volatile inventory. The study of cometary material can therefore help to reconstruct the early history of our Solar System.

We have used the technique of ultrafast two-step laser mass spectrometry (*ultra-L²MS*) to investigate the nature and distribution of aromatic organic matter from comet P81/Wild 2 dust particles collected in aerogel and returned by the STARDUST sample return mission. [1] We have identified complex aromatic hydrocarbons in cometary particles entrained along several aerogel tracks. Although terrestrial contamination issues from the aerogel remain a concern, a substantial fraction of the observed organics appears indigenous. [2] The aromatic fraction of the total organic matter present appears to be lower than that typical of carbonaceous and ordinary chondrites, but shows a greater spectral complexity. Simple fused ring polycyclic aromatic hydrocarbon (PAHs) such as benzene (C_6H_6), naphthalene ($C_{10}H_8$), acenaphthalene ($C_{12}H_8$), phenanthrene ($C_{14}H_{10}$) and pyrene ($C_{16}H_{10}$) are present along with their homologous alkylation series, Ar-(CH₂)_n-H, extending up to $n \sim 6$. In addition, prominent odd-mass peaks are interspersed within these familiar PAH series and are consistent with several interleaved alkylation series of N-containing PAHs (NPAHs). The N is unlikely to be present in the form of a N-heterocycles given the experimental conditions of the *ultra-L²MS* analysis, rather the most probable form of the N functionality is as nitrile (Ar-CN). This may be related to the 2.3 & 4.6 μm adsorption features observed in the spectra of many young stellar objects and some comets, and which has been attributed to a solid material known as "XCN" believed to be synthesized by ultraviolet and/or ion bombardment of precometary icy grains in circumstellar environments. [3] Comparison of the STARDUST spectra with a range of other astromaterials analyzed by *ultra-L²MS* under comparable experimental conditions show a striking similarity with several cluster IDPs.

[1] Sandford, *et al. Science* **314**, 1720 (2006);

[2] Clemett, *et al. MAPS* Submitted;

[3] Whittet, *et al. ApJ*. **550**, 793 (2001)