# Time scales and processes of potassic magma generation at Sangeang Api volcano, eastern Sunda arc

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Primary magmas are rarely erupted from island arc volcanoes and U-series isotopes can provide unique insights into the physical processes of magma evolution by constraining the time scales over which they occurred. This requires rock suites which provide a complete record of the liquid line of descent and Sangeang Api volcano in the eastern Sunda arc provides such an opportunity because it erupts a wide compositional range of potassic lavas which contain a spectrum of xenoliths interpreted to represent the cumulates complementary to the lavas. The cumulates and lavas span a compositional range from 14 to 3% MgO and major and trace element modelling show that these rocks record ~ 70% polybaric, equilibrium crystallisation which began at sub-Moho depths and continued into the upper crust. The parental magmas can be successfully modeled by 3% partial melting, in the presence of 1-4% residual garnet, of a MORB source containing ~ 3% subducted Sunda sediment in addition to a contribution of fluid-mobile elements from the subducting slab. A modest range in Sr, Nd and Pb isotopes which is interpreted to reflect ~ 15% assimilation of Indian MORB crust. Neither interaction with metasomatized arc lithosphere nor the presence of enriched, plume-type mantle in the mantle wedge are required by our data. The cumulates and lavas have indistinguishable ($^{230}$Th/$^{232}$Th) over a wide range of U/Th ratios and thus define a zero age isochron on a U-Th equiline diagram. All whole rocks and minerals are characterized by $^{226}$Ra-excesses and modelling of the $^{226}$Ra-$^{230}$Th-Ba data suggests that magmatic evolution beneath this arc volcano occurs on time scales of less than a few thousand years. It is possible that differentiation occurs even faster than this during isobaric decompression of magmas ascending through conduits. The cumulate xenoliths may represent material torn of the side of the conduits by these ascending magmas, rather than magma chamber fill. An implication is that the net magmatic flux across the Moho is of magmas that are already significantly evolved from primary magmas and this may be significant for why average continental crust has an andesitic bulk composition even though the flux out of the mantle wedge is basaltic.

# A 3D approach to xenon isotopes in interstellar grains

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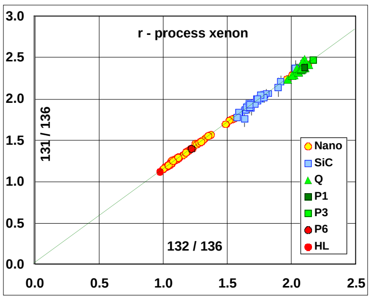
The isotope systematics of xenon, and other elements with three or more isotopes, are usually visualised by the use of 3-isotope mixing diagrams in which isotope ratios with a common denominator isotope are plotted against each other. With nine isotopes and a range of potential components, these mixing diagrams are often inadequate to represent the complexity of xenon and are frequently confusing. Analytical treatments lack the clarity and immediacy provided by graphic visualisation. With the universal availability of personal computers and sophisticated plotting programs, the use of 4-isotope (3D) mixing diagrams can often provide a clearer insight. Xenon compositions are generally discussed in terms of hypothetical end-members (Q, P3, P6, HL, etc.), on the assumption that each end-member is the signature for a specific carrier phase (the rationale on which the major carrier phases have been isolated). In 3D 4-isotope plots the published data form a simple co-planar array indicating clearly the permitted compositions of the underlying three nucleosynthetic components. Projection to the $^{136}$Xe/$^{132}$Xe=0 and $^{130}$Xe/$^{132}$Xe=0 planes defines the respective s- and r-process end members. One of the r-process projections $^{131}$Xe/$^{136}$Xe vs. $^{132}$Xe/$^{136}$Xe is illustrated in the figure.




Several implications follow; (1) P6-Xe differs from HL-Xe by a depletion of s-process and an enrichment of the light r-process component (solar type), (2) the r-process component in SiC is heavier than solar type, which argues against production mechanisms for the heavy r-process component (Xe-HL type) which are specific to nano-diamonds, (3) the proportions of $^{124}$Xe:$^{126}$Xe:$^{128}$Xe:$^{129}$Xe:$^{131}$Xe:$^{132}$Xe:$^{134}$Xe:$^{136}$Xe in the heavy r-(and p-) process component lie between the limits; 0.009, 0.004, 0.034, 0, 0, 0, 0.65, ≡1.0, and 0.125, 0.008, 0.034, 1.5, 1.0, 1.1, 0.9, ≡ 1.0. That r-process Xe in SiC, nanodiamonds and the Sun can be regarded as a simple 2-component mixture argues that the differences arise from a fundamental dependence of the r-process path around Z=50, N=82, on the nucleosynthetic environment (supernova type), rather than on details of the trapping mechanism in particular mineral grains. The difference between r-Xe in SiC and the sun may possibly reflect a secular change in the manifestation of r-process within the galaxy.