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Tristan da Cunha: informing future eruption scenarios using high-precision Ar/Ar dating

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Fifty years ago the remote volcanic ocean island of Tristan da Cunha (South Atlantic) erupted. Although this was the first recorded historical eruption, the volcano exhibits a complex and dynamic eruptive history, with numerous, often compositionally distinct, parasitic centres punctuating the large edifice. However, the precise timing of differing styles of activity remains uncertain. Any attempt at forecasting future eruptive scenarios is dependent upon appraisal of the past eruptive phases of Tristan, however this is challenging due to the dispersal of young parasitic centres ($<$ 50 ka) with a relatively low radiogenic component. This contribution presents 15 new Ar/Ar ages from Tristan, which when coupled with compositional information and vent distribution, place important constraints on spatio-temporal relationships of recent volcanism and provide information into the manner in which the volcanic edifice was constructed.

The youngest dated lava flow was 3 $\pm$ 1 ka (1σ), although further stratigraphically younger deposits exist. The oldest dated lava was 118 $\pm$ 4 ka (1σ) and a large-scale sector collapse was constrained to a 13 kyr window. Data also imply that edifice construction was rapid and piecemeal. No spatio-temporal pattern to parasitic centre activity was found and recent volcanism from these centres varies in style, volume and composition with time, unlike recent activity from other well-dated ocean island systems. The random distribution and compositions of eruptive material suggests that the plumbing system beneath Tristan resembles small pockets of magma that source rapidly from depth. Of particular significance to hazard assessment is the discovery that the summit was contemporaneously active with recent parasitic centre activity on the flanks and coastal strips. A summit eruption has very different hazard implications to localized coastal lava flows, due partly to the steep slopes (20-30°) and deeply incised gulches capable of rapidly channelling eruptive products towards inhabited coastal areas.

These data show with continued developments in Ar isotope extraction tools and noble gas mass spectrometer technology .....(e.g., Mark et al., 2009; Mark et al., 2011), the Holocene will become increasingly accessible to the Ar/Ar geochronologist and precision and accuracy will continue to improve.