Small Scale Arcuate Intrusions on Saint Helena, South Atlantic

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Abstract

Sixteen arcuate intrusions have been emplaced at extremely high levels into the basaltic shield volcanoes of Saint Helena. These intrusions are of special interest because of their small size and modes of emplacement. The arcuate masses are of three distinctive types:

1) Irregular, steeply inward-dipping, basic sheets with diameters of 150 m to 450 m infill tensional fractures originating at depths of about 500 m beneath the volcano surface.

2) Strongly curved sheets from 25 m to 750 m in diameter are cross-sections of inclined intrusions which in three dimensions resemble single sticks of celery. These intrusions, varying from basalt to trachyte in composition, are infilled tensional fractures originating at «point» pressure sources, inclined to the horizontal, at depths of about 500 m below the surface.

3) Salic intrusions with near-vertical sides and gently inclined roof-infillings have outer diameters of 350 m to 1070 m. Pressure exerted onto the flanks of the volcano by domed, convex upwards, areas of a magma chamber roof, at a depth of about 2 km, caused near-vertical ring fractures to form. Formation of a sub-horizontal cross fracture and subsequent intrusion of magma produced the «roof-infillings» by updoming the overlying basalts or sinking of the enclosed block, or combinations of the two processes. Two intrusions of this third type are multiple.

Introduction

Cone sheets and ring dykes are a common feature of deeply eroded igneous areas all over the world. Most of these arcuate intrusions have diameters of several kilometers, although the central block of a ring dyke system may be as little as one kilometer across (Richey and Thomas, 1930; Jacobson, et al., 1958). In areas of active volcanism, pit craters, without visibly associated intrusions, have
diameters at the surface of a few hundred meters or less (Wentworth and MacDonald, 1953).

A number of arcuate intrusions on Saint Helena, in the South Atlantic (see inset, Fig. 1), are of special interest because of their unusual forms and exceptionally small size. The intrusions, with one exception, have outer diameters of less than 800 m and were intruded into the volcano at extremely high levels. The intrusions are of three distinct types:

i) Irregular basic sheets dipping inwards at high angles.
ii) Strongly curved, bilaterally symmetrical sheets dipping towards an axis inclined to the horizontal.
iii) Large salic masses with near-vertical sides and infilled «roof-cavities».

![Fig. 1 - Locality map of the Saint Helena arcuate intrusions; arrows denote dominant dip of shield-forming lavas of the two volcanoes.]