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Dynamic evolution of the Mt. Cameroon volcanic edifice

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The growth and destruction of a volcanic edifice reflects dynamic processes that shape the Earth, including transport of mass and heat in a cooling planet versus the mechanical and chemical degradation of igneous material driving toward equilibrium. Central to understanding the nature of volcanoes are determinations of the rates of change in the volumes of these features. Through a quantitative temporal framework it is possible to elucidate the relative importance of competing processes that govern growth and destruction of volcanoes, e.g., magma production versus mass wasting. As the energetics of constructive and destructive processes are directly linked to the hazards that they pose to human populations and because volcanoes are stochastic systems, the only means of long-term forecast is via comprehensive understanding of volcanic history.

Mount Cameroon is one of Africa's largest volcanoes and is currently the only active centre on the Cameroon line. The edifice is 4 km high with a volume of at least 1200 km3. Seventeen eruptions have been reported since 1800 and a time-averaged eruption volume of 6 x 106 m3/year is calculated from 7 eruptions over the past 91 years.

Eight new Ar/Ar ages have been determined for basaltic rocks distributed across Mt. Cameroon; plateau ages are 4139±19 ka, 195±2 ka, 187±5 ka, 161±2 ka, 82±4, 68±3, 14±4 and 2±4 ka (1σ). The upper age from this set defines the oldest age yet measured for the Mt. Cameroon system. The data demonstrate activity through the mid to upper Pleistocene, continuing through to modern activity.

Using recent estimates for basin-wide erosion of ca. 0.05 mm/a on a similar edifice (Kauai, Hawaii, Gayer et al 2008) and extrapolating over the Mt. Cameroon edifice yields an erosion rate of 5x104 m3/a, a factor of 30 times lower than the modern magma production rate. Considering these two fluxes implies that approximately 700 ka is required to construct an edifice of 1200 km3 (the current volume of Mt. Cameroon). This discrepancy can be reconciled if 1) the modern magma production rate is higher than the time averaged rate over the life of the edifice, 2) an additional mass wasting process such as large-scale land sliding partially compensates for the high rate of magma production or 3) spatially averaged erosion rates are higher by factor of ca. 20.

Further study using Ar/Ar dating to constrain magma production rates and cosmogenic 3He to define spatially averaged erosion rates will further constrain the mass flux on this edifice with the aim of informing volcanic hazard assessments.

References cited: Gayer et al. (2008), Earth and Planetary Science Letters 266 (2008) 303–315.