

## **Sulfur Isotope Systematics of the 1982 El Chichón Trachyandesite: An Ion Microprobe Study**

J F Luhr (Department of Mineral Sciences, NHB-119, Smithsonian Institution, Washington D.C. 20560; ph. 202-357-4809; fax 202-357-2476; e-mail: [luhr@volcano.si.edu](mailto:luhr@volcano.si.edu)); M. Amelia V. Logan (Department of Mineral Sciences, NHB-119, Smithsonian Institution, Washington D.C. 20560; ph. 202-357-2315; fax 202-357-2476; e-mail: [logan.amelia@nmnh.si.edu](mailto:logan.amelia@nmnh.si.edu))

Sulfur isotopic compositions were determined by ion microprobe for 36 spots on anhydrite crystals in trachyandesitic pumices erupted from El Chichon volcano, Mexico, in 1982. Individual anhydrite crystals are homogeneous in  $\delta^{34}\text{S}$ , within the  $\pm 1$  permil (2-sigma) uncertainty of the method, but crystal-to-crystal variations are large (+2.5 to +10.9 permil). Variations in  $\delta^{34}\text{S}$  show no correlation with complex textures in anhydrite revealed by cathodoluminescence color. Two models for the origin of this wide isotopic variability among anhydrites are considered viable: mixing of magmatic anhydrite with isotopically heavier hydrothermal anhydrite, and mixing of anhydrite crystals precipitated from different domains of the magma reservoir that were variably depleted in sulfur and enriched in  $^{34}\text{S}$  through progressive degassing prior to eruption. No evidence supports assimilation of sedimentary sulfate as an explanation for the high sulfur content of the El Chichon magma or for the wide variability in  $\delta^{34}\text{S}$  of anhydrite. Ion-microprobe analyses of  $\delta^{34}\text{S}$  were also obtained on six ovoid-shaped inclusions of pyrrhotite, chalcopyrite, and/or intermediate sulfide solid solution hosted by silicate or oxide crystals, interpreted to be magmatic ( $\delta^{34}\text{S} = -0.1$  to  $+2.7$  permil; mean  $+0.7$  permil), and on four irregularly shaped multiphase sulfide fragments in the matrix, interpreted as xenocrystic, which range widely in  $\delta^{34}\text{S}$  ( $-3.7$  to  $+5.5$  permil). The results of this study and other recent investigations prompt a re-evaluation of the sulfur budget for the 1982 El Chichon eruption. We estimate that  $2.2 \times 10^{13}$  g of S was emitted, and that 58 wt.% of the sulfur was present as anhydrite prior to eruption, with the remainder in a vapor phase having  $\text{H}_2\text{S}/\text{SO}_2 = 9$ . The bulk magmatic  $\delta^{34}\text{S}$  value for the El Chichon trachyandesite remains unchanged from earlier estimates at  $+5.8$  permil, typical of the relatively heavy sulfur isotopic compositions that characterize subduction-related magmas.