



Graben-calderas. Volcano-tectonic explosive collapse structures of the Sierra Madre Occidental, Mexico

G.J. Aguirre-Diaz (1), G. Labarthe-Hernandez (2), M. Tristan-Gonzalez (1,2), J. Nieto-Obregon (1), I. Gutierrez-Palomares (1)

(1) Centro de Geociencias, Universidad Nacional Autonoma de Mexico, (2) Instituto de Geologia, Universidad Autonoma de San Luis Potosi, Mexico
(ger@geociencias.unam.mx/Fax:+5256234101/Campus UNAM-Juriquilla, Queretaro, CP 76230, Mexico)

The Sierra Madre Occidental (SMO) is the largest continuous ignimbrite province in the world, with a minimum estimated volume of 390,000 km³. The Ignimbrite Flare-up in Mexico was a period of intense explosive volcanic activity that produced an enormous volume of silicic ignimbrite sheets at the SMO, which took place mainly between 38 and 23 Ma. Although some are related to classic semi-circular calderas, a large proportion of these ignimbrites were erupted from fissural vents related to grabens and fault systems associated with the Basin and Range extension. The evidence includes large pyroclastic dikes, co-ignimbrite lithic lag breccias, and post-ignimbrite aligned rhyolitic domes and rhyolitic lava dikes, all occurring along the graben walls or on the graben's shoulders.

We propose the name of graben-caldera for a volcano-tectonic explosive collapse structure in which large-volume ignimbrite-forming pyroclastic flows were erupted through several fissural vents mainly along the master faults but also along internal faults of the graben, resulting in the volcano-tectonic collapse of the graben or of a sector of the graben. This implies the existence of a sub-graben-caldera magma chamber that was controlled by the regional extensional tectonics, in this case, the Basin and Range extensional regime. The graben-calderas observed in the SMO include three types, single-block (piston equivalent), piece-meal (the most common), and half-graben-caldera (trap-door equivalent). The volcanic sequence associated to the graben-calderas of the SMO in general consists of a pre-major ignimbrite sequence of pyroclastic surge deposits and minor ignimbrites, followed by the major ignimbrite,

and then the emplacement of silicic lava domes along the fissural conduits. This sequence represents the typical graben-caldera cycle in the SMO: a magma chamber depressurisation phase (surge deposits), the graben-caldera collapse and eruption of large-volume ignimbrite-forming pyroclastic flows (major ignimbrite), and the post-collapse emplacement of degassed magma as lava domes through the main faults of the collapsed structure. Plinian fallout phase is not evident in the SMO graben-caldera volcanic cycle. In some cases the graben-caldera vents are related to gold and silver hydrothermal mineralization, and thus, understanding this relationship will be important for economic purposes. Similar volcano-tectonic structures apparently occur at other volcanic provinces in the world, including the Andes (La Pacana), United Kingdom (Scafell), and the Pyrenees (Catalan Permo-Carboniferous sequence).