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AVALANCHA CATASTROFICA DE DETRITOS DEL VOLCAN SOCOMPA, ANDES DEL NORTE DE CHILE

CATASTROPHIC DEBRIS AVALANCHE DEPOSIT OF SOCOMPA VOLCANO, NORTHERN CHILE

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At some point in its recent history, the Socompa volcano in northern Chile experienced a catastrophic collapse of a 70° sector of the original cone, causing a debris avalanche that descended nearly 3000 m vertically and travelled more than 35 km from the volcano. Attention was first drawn to the presence of unusual deposits at Socompa by Deruelle (1978), who attempted to intepret them in terms of nuee ardente deposits. The scale and physical characteristics of the deposits, however, clearly indicate that a gravity-driven debris avalanche was the dominant feature. As in the May 1980 eruption of Mt. St. Helens, collapse of the volcano triggered a major explosive eruption.

The avalanche deposits cover some 490 km^2 and have a minimum volume conservatively estimated at 15 km^3, and probably have a volume of 25 km. They are therefore about an order of magnitude larger than those of the Mt. St. Helens debris avalanche (2.8 km^3; Voight et al. 1981, 1983). Parts of the original cone slumped in a nearly coherente form and are now preserved as large blocks more than 400 m high. These have the morphology of classic lanslide slumped and rotated blocks ("toreva" blocks in the terminology of Reiche, 1937), but are larger than those in typical terrestrial landslide deposits. They are comparable in scale with those in the large landslide in Gangis Chasma, Mars (Lucchitta (1978)). The avalanche appears to have been highly mobile, with H/L ratio around 0.07, comparable with pyroclastic flows (Ui, 1983). An unusual aspect of the Socompa debris avalanche deposit is that it contains a large proportion of ignimbrite material, derived from the Arenosa ignimbrite which underlies the volcano. A proportion of a distinctive Quaternary gravel formation is also present. These observations indicate that the original failure surface extended beneath the volcano into the sub-volcanic basement.

Primary and secondary components can be recognised in the avalanche deposit. The primary avalanche travelled northwestward over sloping ground before coming to rest transiently, forming a prominent marginal ridge, and then slid away north eastward in a major secondary flow, over-riding much of the primary avalanche deposit.

Directed explosions associated with volcanic collapse associated with the emplacement of debris avalanche deposits are likely where collapse is associated with magmatic activity, as at Mt. St. Helens and Bezymianny (Siebert, 1984). At Socompa, prismatic jointed dacite blocks are abudant within the debris avalanche deposit. These blocks are exceptionally fragile when cool, and must therefore have been transported in a hot and plastic condition (c. f. Francis et al., 1974), indicating that a hot lava or dome was present at the time of collapse, and that the collapse was therefore probably triggered by magmatic activity. Evidence for an associated violent blast is less clear, but the presence of a thin, fine

grained pumiceous deposit beneath the debris avalanche deposit is prima facie evidence for an explosive blast.

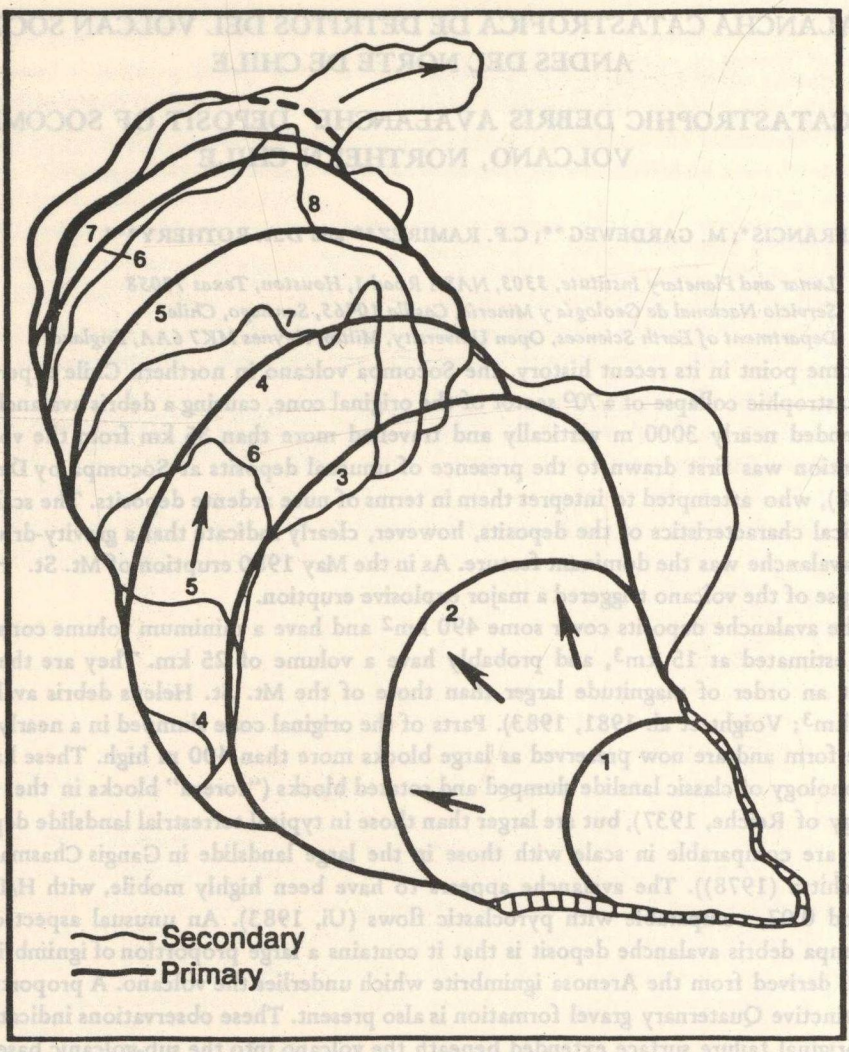

Fig.1. Computed trajectories for primary (bold line) and secondary (thin line) Socompa avalanches at successive minutes of elapsed time. Velocites based on those observed for Mt. St. Helens.

Fig.1. Trayectorias calculadas para las avalanchas primarias (línea gruesa) y para las avalanchas secundarias del volcán Socompa, a minutos sucesivos de tiempo transcurrido. Las velocidades usadas se basan en aquellas observadas en el Monte St. Helens.

Collapse was followed by eruption of pumiceous pyroclastic flows which form an apron on the west flanks of the volcano (the Campo Amarillo) which is spatially and stratigraphically closely analagous to the pumiceous pyroclastic flows of Mt. St. Helens May 18. (Rowley et al. 1981). A thick plinian pumice deposit mantles the north eastern flank of the volcano, and is further evidence that the Socompa eruption closely resembled that of Mt. St. Helens, but on a larger scale. Subsequent to the eruption, extrusion of volu-

minous dacite domes continued over a long period, constructing a lava pile which now nearly fills the original amphitheatre, and which may be as much as 2 km thick. The youngest activity on Socompa has taken place on the summit domes, where five small explosion craters are located.

Determination of the age of the major eruption is likely to be difficult, in the absence of written records. Glacial deposits are common on Central Andean volcanoes at heights above 4,300 m (Hollingworth and Guest, 1967). The absence of such deposits on Socom- indicates that the collapse post-dates the last glacial episode, and therefore took place less than 10,000 yr ago.

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