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Perspective

Ignimbrites: stratigraphic marker and record of the magmatic and tectonic evolution

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Developments of experimental simulations and theoretical modelling during the last decade have improved the understanding of the physics of silicic explosive eruptions and particularly the mode of emplacement of the pyroclastic flows [9]. Ignimbrite is a sort of pyroclastic flow that can result from the gravitational column collapse associated to plinian eruption from stratovolcano clusters [16] or to the sustained fountaining of lower eruptive columns (*boiling-over*) during caldera-forming eruptions [6].

In the first case, the volumes concerned are relatively small and the pyroclastic material, largely confined to valley between volcanic edifices, only travels a few kilometres. These ignimbrites are poorly to non-welded and are rapidly carved by erosion. The Peruvian ignimbrites recently described by Paquereau et al. [14] belong to this kind of pyroclastic flow. The estimated volumes (< 20 km^3) and lateral extension (< 20 km) of two of their ignimbritic units are within the range of the 1912 ignimbritic eruption of Katmai in Alaska [11,12]. These flat-topped deposits are the most reliable stratigraphic marker in subduction zones such as the Andean Cordillera, where lava flows have limited extension. They are also useful material for high-resolution ^{40}Ar/^{39}Ar dating because they contain potassium-rich phases such as biotite, K-feldspar and glass.

In caldera forming eruptions the volumes involved and the run-out distances of the outflow ignimbrites are several orders of magnitude higher. A number of Miocene and Pliocene ignimbrites in the Central Andes (20°–25°S) have estimated eruptive volumes in excess of 1000 km^3 [7,13,15,17]. These high discharge rate eruptions flood huge areas, forming prominent morphological markers that have been used for regional correlations and dating of tectonic movements in relation to the structural evolution of the Andes. Welding is a common feature in these voluminous ignimbrite sheets. A recent review [8] contributes to a better understanding of the physical parameters involved in this process.

A peculiar feature of some pyroclastic flows is their ability to traverse topographic barriers and climb obstacles up to 1000 m [6]. Two interpretations have been proposed: the temporary blocking of a valley-confined sustained pyroclastic density current by a topographic high until it can surmount this barrier, as proposed for the Acatlán ignimbrite in Mexico [2], or the high momentum of thin pyroclastic flows, as was suggested for the Taupo ignimbrite in New Zealand [3,18]. Paquereau et al. [14] assume that the 4.88-Ma La Joya ignimbrite ($\sim$20 km^3) in Peru was able to onlap the 350-m high Arequipa batholith, located at about 20 km from its presumed source. However, strong field evidence is lacking in their paper to easily accept this assumption.

Ignimbrites are highly differentiated liquids; fractional crystallisation and assimilation of crustal material is generally considered as a suitable mechanism to produce low to moderate volumes of this material [10]. The genesis of huge volumes of silicic magmas is more controversial. Some recent papers coincide in considering this kind of ignimbrites as the volcanic expression of a batholith-sized magma body [1]. This model infers that the near-solidus crystal mush installed at an

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upper crustal level can be rejuvenated following a voluminous injection of mafic magma to produce acidic magmas that erupted explosively at the surface. As the input of basic material is mainly driven by extensional faulting, the ignimbrite flare-up is also a key marker of the tectonic regime. In the central Andes, widespread ignimbrite volcanism was thus related to crustal thickening and increased magmatic input into the base of the crust in relation to variation in slab geometry [4,5].

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