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New stratigraphic, chronologic, and magnetic fabric constraints for Neogene and Quaternary ignimbrites in the Central Andes (South Peru)

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Central Andean deformation history in southern Peru is recorded in Neogene volcanic units of Ocoña and Cotahuasi canyons that cut across the western Cordillera. Acceleration (<25 Ma) of uplift in the region is reflected in the Neogene epiclastic deposits with interspersed and subsequent rhyolitic ignimbrites between 24.6 and 1.37 Ma. Large-volume (>100 km3) Nazca (c.24.6 Ma), Alpabamba (19.4-18.0 Ma), and Huaylillas (14.25–12.7 Ma) ignimbrite sheets preceded the canyon incision, whereas sheets of smaller volume (<50 km3), Caraveli (9.5-8.9 Ma), Lower (5.13–3.6 Ma) and Upper Sencca (c.2 Ma) and Las Lomas (c.1.56-1.37 Ma), were deposited during canyon incision and are interspersed with Lower and Upper Barroso lava flows.

The Alpabamba compound ignimbrite sheets comprise a vitrophyre at the base, grading into a strongly welded, eutaxitic, crystal-rich facies overlain by a thick, multi-bedded ash-flow tuff and a lithic-rich, indurated flow unit. The Huaylillas ignimbrite sheet comprises a strongly welded, crystal-rich, lithic-poor, columnar lithofacies, with devitrified pumice. The Caraveli ignimbrite sheet has a jointed vitrophyre overlain by a welded, blocky, crystal-rich flow unit. A vacuolar, saccharolytic unit forms the top of the sequence. The Lower Sencca ignimbrite sheet comprises of a basal vitrophyre and a slightly welded, fibrous pumice-rich flow unit, which grades into a welded, vapor-phase unit that contains more crystals than pumice and lithics. The Upper Sencca ignimbrite sheet consists of a black vitrophyre, grading into a strongly welded, crystal-rich, eutaxitic cooling unit. The latter is capped by a slightly welded unit, and an indurated pumice-rich, crystal-poor vapour-phase facies. Quaternary valley-fill termed Las Lomas consists of unwelded, crystal-poor pumice-flow deposits.

Eighteen new 40Ar/39Ar analyses have been carried out on feldspar/glass separates from pumice and lavas. Results for the Caraveli ignimbrite (9.35±0.06 Ma), Upper Barroso lavas (2.24±0.45 Ma) and Upper Sencca ignimbrite (2.00-2.06±0.09 Ma) are in good agreement with previous data. New ages for the Lower Barroso lavas (7.32±0.05; 5.36±0.12 Ma) and Lower Sencca ignimbrites (5.13±0.01, 5.09±0.03, 4.65±0.11, 4.36 ± 0.16) extend their temporal history towards older times. Lower Barroso lava flow activity occurred as early as∼7.3 and lasted until 5.4 Ma just before the Lower Sencca eruptions. The Lower Sencca ignimbrites spanned at least 1.5 Ma and are larger and more widespread than the Upper Sencca ignimbrites, which may have formed in one pulse around 2 Ma.

The Anisotropy of Magnetic Susceptibility (AMS) method and the magnetic fabric at 24 sites have been used to indicate flow directions and to infer the source location of the rhyolitic ignimbrites. Mean directions and confidence cones were calculated using Bingham statistics. Most AMS ellipsoids are oblate with near-vertical, slightly imbricated minimum susceptibility directions. The magnetic signal is dominantly carried by coarse multi-domain and a few fine single-domain grains of titanomagnetite. Inferred transport directions based on AMS results reveal that the source of Huaylillas, Lower Sencca and Upper Sencca units is probably located below the Nevado Coropuna volcano. The source of the Caraveli unit points to a depression W of Nevado Sara Sara. The Alpabamba source could not be clearly determined.

Keywords: ignimbrites, Peru, stratigraphy, chronology, AMS, fabric, Neogene, Quaternary.