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Neogene and Quaternary ignimbrites in the Arequipa area, southern Peru: Stratigraphical and petrological correlations

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Our study focuses on the correlation of four newly identified rhyolitic ignimbrites located in and around the Arequipa basin (**Table 1, Fig. 1**, Paquereau et al., in press), previously described as a single ignimbrite sheet.

The four ignimbrites are: 1) The Rio Chili ignimbrite (RCI, ca. 13.33 Ma, **Table 1**) of unknown distribution. This appears in the Rio Chili canyon only (eastern part of the Arequipa basin, **Fig. 1**) and consists of a cooling unit of non- to partially welded massive crystal-rich lapilli tuffs. This ignimbrite may be stratigraphically equivalent to the 14-13 Ma-old Huaylillas ignimbrites in Southern Peru (Thouret et al., 2004) and represents the base of the Neogene ignimbrite succession in the Arequipa area. 2) The voluminous (~ 20 km^3) and widespread La Joya ignimbrite sheet (LJI, ca. 4.87 Ma, **Table 1**) has filled in the Arequipa depression. Its probable source area is now buried beneath the Chachani volcanic complex. The La Joya ignimbrite covers both the Arequipa Batholith toward the Rio Vitor piedmont and also part of the Altiplano East and North of the Chachani volcanic complex (**Fig. 1**). In the Rio Chili canyon the La Joya ignimbrite is composed of three welded massive lapilli tuffs. 3) The Arequipa airport ignimbrite sheet (AAI, ca. 1.6 Ma, ~ 18 km^3, **Table 1**), the third and latest infill of the Arequipa Basin (**Fig. 1**), consists of a lower white, columnar jointed, massive lapilli tuff, indurated by vapor-phase recrystallisation and overlain by an upper pink, lithic-rich, non-welded massive lapilli tuff. The source of this ignimbrite is also buried beneath the Chachani complex, as indicated by AMS (Paquereau et al., this issue) and component lithology. 4) The Yura non-welded pumice-flow deposits (YT, ca. 1.02 Ma, 1.5km^3, **Table 1**) are restricted to the northern and western flanks of the Chachani complex (**Fig. 1**) and may be equivalent to the tuffs and tephra layers of the Capillune Formation found on the Altiplano.

All ignimbrites are high-K calc-alkaline to alkaline rhyolites which contain variable amount of plagioclase, biotite, quartz, sanidine and Fe-Ti oxides (**Table 1**). The modal composition of mineral phases (occurrence or lack of amphibole) and chemistry of amphibole and biotite are good correlation tools. In fact, the Rio Chili and La Joya ignimbrites are distinctive in containing amphibole that has a higher Ti, Al, and Fe content in the Rio Chili ignimbrite amphibole. The four ignimbrites are characterised by specific geochemical fingerprints. Sr, Y, Yb, Rb, Ba, REE and Sr isotopes are the most effective discriminator elements (**Fig. 2**). The younger Arequipa Airport ignimbrite and Yura Tuffs suffer stronger crustal contamination than the older La Joya and Rio Chili ignimbrites, which can be accounted for by a longer residence time during its genesis in the shallow crust (**Fig. 2D**).

The voluminous (> 40 km^3) Neogene ignimbrites of the Arequipa area reflect three major explosive volcanic pulses in the Central Volcanic Zone in Southern Peru, whose genetic relationships with tectonic uplift and crustal thickening of the Western Cordillera (and Altiplano) are still in debate.

References

Paquereau, P., Thouret, J.C., Wörner, G., Fornari, M., Macedo, O., Roperch, P., in press. Caractérisation des ignimbrites néogènes du basin d'Arequipa, Pérou. C. R. Géoscience, in press.

Paquereau, P., Roperch, P., Thouret, J.C., Giordano, D., Russell, K.., this issue. Neogene ignimbrites in the area of Arequipa, Southern Peru: Paleomagnetism and Welding.

Thouret, J.C., Wörner, G., Singer, B., Legeley-Padovani, A., 2004. "Old" valleys in a "young" mountain range. Published abstract and poster, IAVCEI General Assembly, Pucon Chili, 14-19 November 2004.

Arequipa Ignimbrites	Lithofacies	Preserved extent, average thickness and volume	Mineral assemblage	$^{40}Ar/^{39}Ar$ ages in Ma
Yura Tuffs (YT)	stratified ash and pumice flows	extent ~ 150 km2 thickness = 10 to 50 m volume ~ 1.5 km3 High Aspect Ratio (HAR) ($1.4.10^{-3}$)	plag. > san. > qz. > biot. > ox.	**1.03 ± 0.09** (on biotite)
Arequipa Airport Ignimbrite (AAI) — **pink unit**	lithic-rich massive lapilli-tuff (mLT)	extent ~ 600 km2 thickness = 5 to 100 m volume = 18 to 20 km3 HAR ($1.4.10^{-3}$)	plag. > biot. > ox. > qz. > san.>> amph	**1.65 ± 0.04** (on biotite)
Arequipa Airport Ignimbrite (AAI) — **white unit**	mLT, columnar jointed		plag. > biot. > ox. > qz. > san. vapor phase silica: cristobalite	
La Joya ignimbrite (LJI)	mLT, columnar jointed	**extent ~ 800 km²** thickness = 5 to 80 m **volume ~ 16 to 24 km3 Middle Aspect Ratio (MAR) ($6.4.10^{-4}$)**	plag. > **san. > qz. >** biot. > ox. > amph. devitrification silica phase:Cristobalite and tridymite	**4.89 ± 0.02 and 4.78 ± 0.21** (on sanidine)
Rio Chili ignimbrite (RCI)	crystal-rich mLT	unknown extent **thickness = 50 to 200 m**	plag. > **amph.** > biot. > san. > qz. > ox. devitrification silica phase: cristobalite and tridymite	**13.19 ± 0.09** (on biotite, averaged 3 ages)

Table 1 : characteristics and ages of the Arequipa ignimbrites.

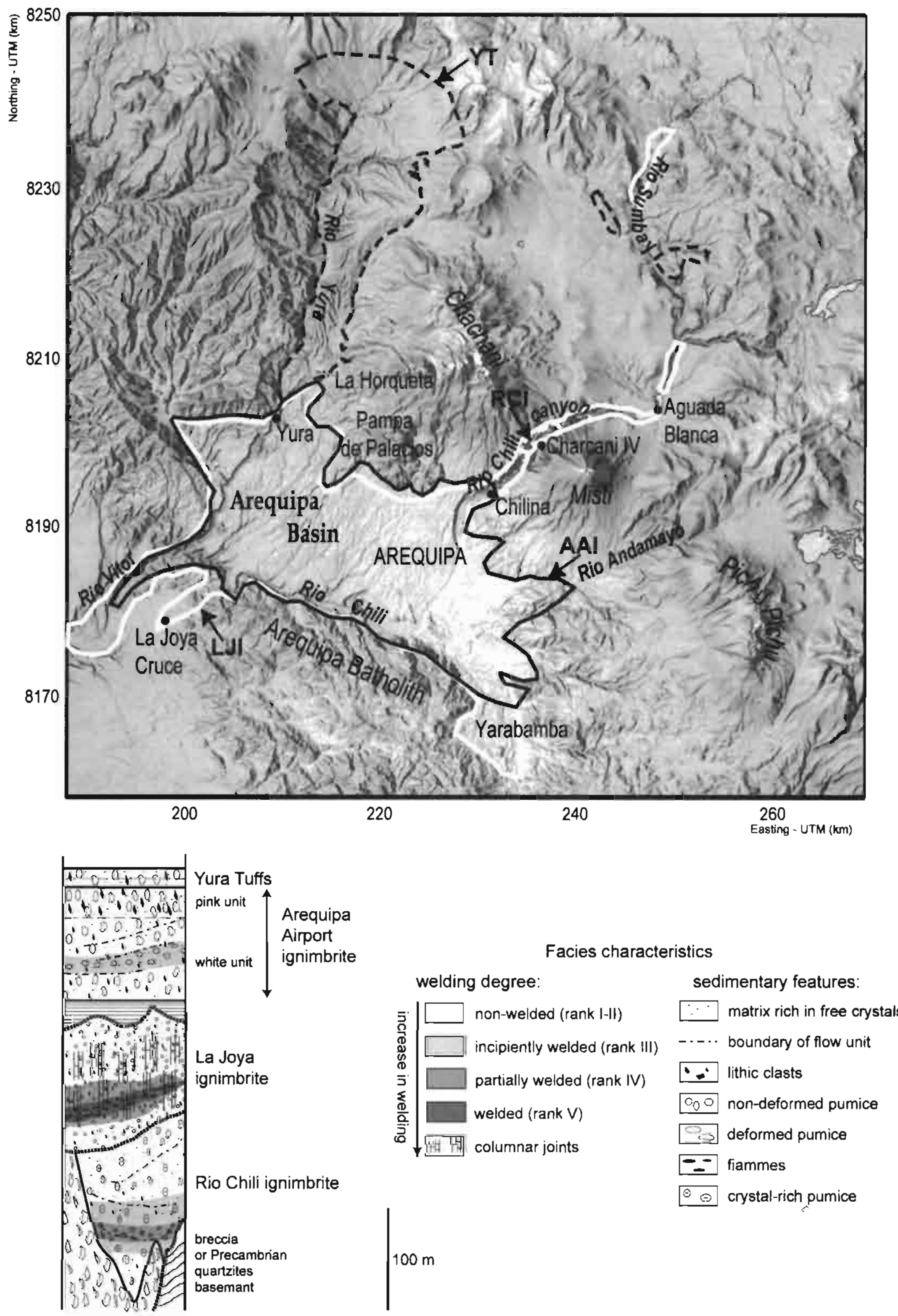

Figure 1 : DEM of the Arequipa area (from the USGS web site), showing locations quoted in the text. The approximate boundaries of the four ignimbrites are shown. Synthetic stratigraphic section of the Neogene ignimbrites of the area of Arequipa with facies characteristics.

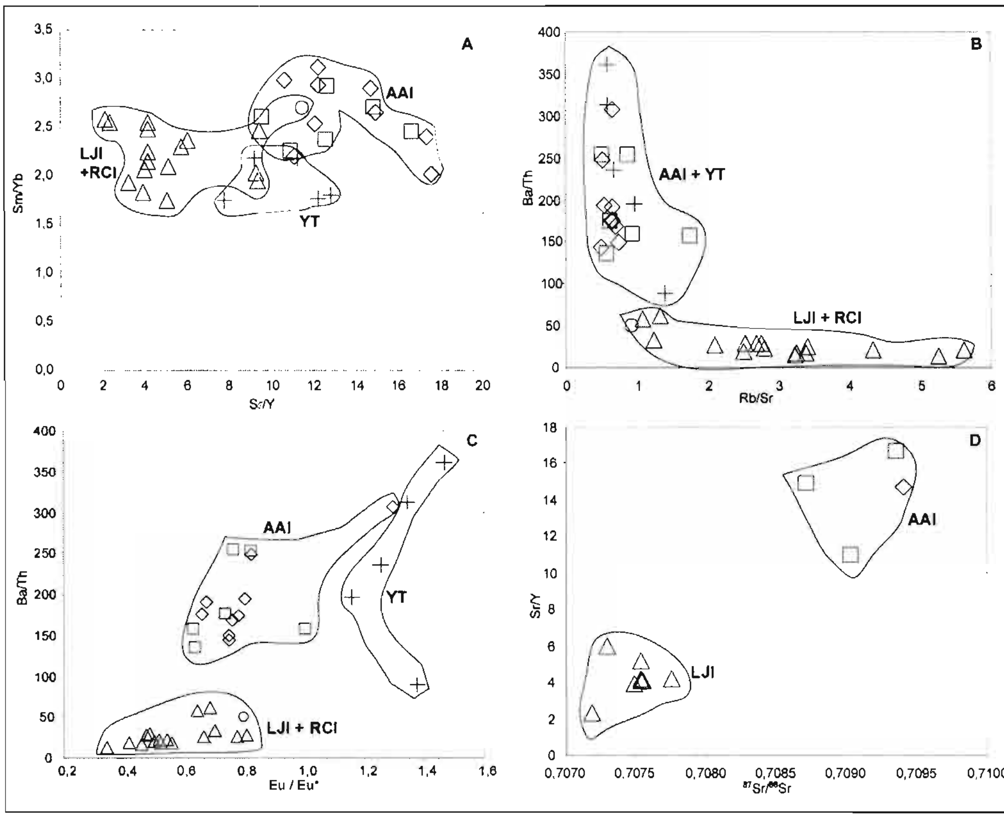

Figure 2 : Trace elements, trace elements ratio and Sr isotopes discriminent plots for Arequipa area ignimbrites. A) Sm/Yb versus Sr/Y (indicators of depth of assimilation, garnet signature), B) Ba/Th v. Rb/Sr, C) Ba/Th v. Eu/Eu*, and D). Sr isotopic composition versus Sr/Y.

Two compositional groups can be distinguished. The first group consists in the Miocene RCI and Pliocene LJI, for which different amphibole chemistry helps to distinguish the two ignimbrites. The LJI is more evolved than the other ignimbrites in terms of major and incompatible elements (e.g. high SiO_2, K_2O and Low CaO and MgO; higher enrichment in Cs, Rb, Th, U, and LREE; negative Ba anomaly and Eu/Eu*). Its Sr isotopic composition is less radiogenic than for the AAI. Therefore, the more evolved LJI has suffered less influence of crustal assimilation. The second group is consistent with the younger AAI and YT. Positive Eu-anomalies for the YT helps to distinguish the two members. These two ignimbrites are less evolved than the LJI and RCI (Lower enrichments in LILE and LREE; weaker or no negative Eu/Eu* and no Ba anomaly). The AAI has more radiogenic Sr isotopic composition than the LJI, reflecting more important crustal assimilation. Note that the low Sm/Yb and Sr/Y ratio associated to high values of $^{87}Sr/^{86}Sr$ are attributed to crustal assimilation in the shallow level of the crust.