Late Pleistocene and Holocene tephrochronology of Mendoza Province, Argentina

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Abstract. Rhyolitic pyroclastic flows and tephra from the Pleistocene (450 ± 60 ka) eruption of the Laguna Diamante caldera comprise the largest volume of pyroclastic material in northwest Mendoza Province. However, trace-element data indicate that 1-3 meter thick rhyolite tephra deposits, which outcrop on both the southwest (Cacheuta) and northeast (Borbollon) margins of the city of Mendoza, have an independent origin. These chemical data, and preliminary chronology, imply at least two different large late Pleistocene eruptions, both younger than that of the Diamante caldera, possibly of Tupungato volcano or the Tupungatito caldera. Tephras from these eruptions also outcrop sporadically in late Pleistocene sediments along the international highway (Route 7) from the border with Chile to Mendoza. Numerous Holocene andesitic to rhyolitic tephra deposits outcropping along the Andean precordillera are evidence for explosive Holocene activity of a number of Andean volcanoes located near the northern end of the Southern Volcanic Zone (SVZ), in the northern (NSVZ; 33-34°S) and transitional (TSVZ; 34-37°S) SVZ, including possibly Tupungato, Tupungatito, Marmolejo, San Jose, Maipo, Overo, Palomo, Calder del Atuel, Sosneado, Rísco Plateado, Tinguiririca, Planchón-Peteroa, Calabozos, Decabazado Grande, Cerro Azul, San Pedro-Pellado, Laguna del Maule, Nevado de Logaví, Domuyo, Nevados de Chillán and Troman.

Keywords: Andean volcanism, tephra, tephrochronology, Mendoza, Argentina

1 Introduction

Many of the Andean volcanic complexes in the Transitional (34-37°S; TSVZ) and Northern (33-34°S; NSVZ) end of the Southern Volcanic Zone (Fig. 1; Stern, 2004) are located on or close to the international border between Chile and Argentina along the High Andean drainage divide. Late-Pleistocene and Holocene explosive eruptions of these volcanoes have produced pyroclastic flows and tephra-fall deposits in the province of Mendoza, Argentina. Historic eruptions of these volcanoes in Chile are catalogued by Gonzáles-Ferrán (1995), and Fontijn et al. (2014) compiled evidence of large Holocene explosive eruptions preserved in tephra deposits, which for the area in question includes only the 1932 AD historic eruption of Cerro Azul (Quizapu). Pyroclastic flows from large Pleistocene rhyolitic eruptions of the Colorado (550 ka; Tormey et al., 1989), Laguna Diamante (450 ka; Stern et al., 1984) and Calabozos (300 and 150 ka; Hildreth et al., 1984) calderas have also been well documented. Here we present preliminary results from a study in progress of late Pleistocene and Holocene tephra deposits in the province of Mendoza, Argentina. These results indicate that large late Pleistocene tephra deposits around the city of Mendoza were not derived from the 450 ka Laguna Diamante eruption, but from multiple younger eruptions of some other source, and that numerous Holocene tephra deposits outcropping along the Andean precordillera provide evidence of explosive eruption, some possibly large, of a number of different Andean TSVZ and NSVZ volcanoes.

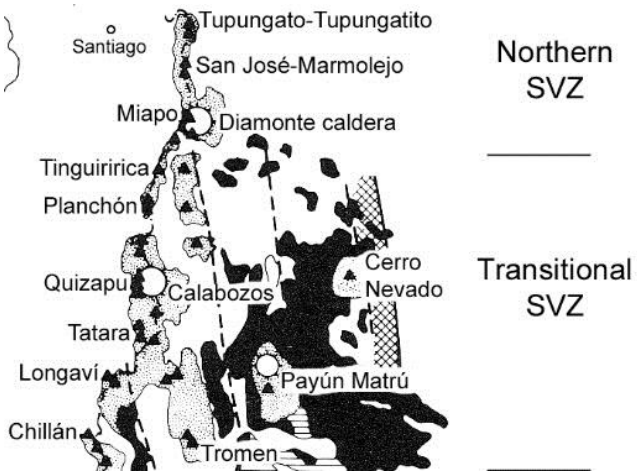

Figure 1. Map of the Andean arc and back-arc volcanoes at the northern end of the Andean Southern Volcanic Zone (33-37°S; Stern, 2004) that have produced late-Pleistocene and Holocene pyroclastic deposits in the Province of Mendoza.

2 Samples and Results

2.1 Late-Pleistocene pyroclastic deposits near the city of Mendoza

One to three meter thick deposits of rhyolite tephra occur near the airport at Borbollón just to the northest (Fig. 2) and at Chacras de Coria and Cacheuta to the south and southwest of the city of Mendoza. Other outcrops of rhyolite tephra occur in Pleistocene sediments at sporadic locations along the international highway from Chile to Mendoza (Fig. 3) and to both the north in the area of Capdeville (Fig. 4) and

to the south near the city of Tupungato. At Capdeville there are clearly two distinct layers (Fig. 4). The trace element chemistry of these two layers are distinct, and the various deposits in the area fall into two groups similar to these two layers (Fig. 5), and both chemically different than the 450 ± 60 ka Laguna Diamante tuff.

Figure 2. A two meter thick outcrop of late-Pleistocene rhyolite tephra at Borbollón just north of the city of Mendoza.

Figure 3. Late-Pleistocene rhyolite tephra at Chacay along the international road Route 7 just west of the city of Uspallata.

Glass fission track ages for outcrops that are chemically identical with the older Capdeville 1 layer, which include the outcrops at Borbollón (Fig. 2), Chacay (Fig. 3), Cortaderas and near the city of Tupungato, yield an average late Pleistocene ages of 152 ± 40 ka (Fig. 5; Espizúa and Bigazzi, 1998; Moreiras et al. 2015), while an Ar^{39}/Ar^{40} on biotite for a chemically similar tephra southwest of Uspallata yielded an older age of 350 ± 80 ka (Moreiras 2006; Moreiras et al. 2015). The upper Capdeville 2 layer is younger, and outcrops of tephra chemically similar to this layer also occur at a number of localities south and west of Mendoza.

Figure 4. Two layers of late-Pleistocene rhyolite tephra at Capdeville north of the city of Mendoza.

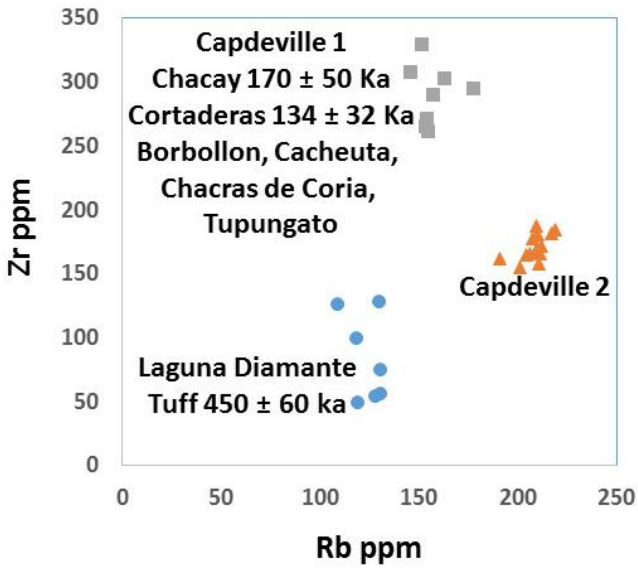

Figure 5. Rb versus Zr content of late Pleistocene tephra in the vicinity of the city of Mendoza. A number of the thicker units have chemistry similar to the older of two different layers of tephra at Capdeville (Fig. 4).

2.2 Holocene tephra deposits in the province of Mendoza

Outcrops of Holocene tephra also occur at numerous locations along the precordillera in the province of Mendoza, including from north-to-south at Cerro La Gloria in the city of Mendoza (Fig. 6), Barrancas to the southeast of the city, in the valley of the Río Atuel (Fig. 7) close to the Atuel caldera and Sosneado volcano, along Río Salado

leading to Las Leñas east of Tinguiririca, along Río Grande (Scotti and Torres, 2012) east of Planchón-Peteroa, along the road to Pehuenche pass (Fig. 8) east of Laguna del Maule, and further to the south along the Río Colorado. Along the Río Colorado, two early Holocene tephra, dated between 11,841 and 13,844 have been described from the Huenul cave excavation (Fig. 9; Barberena et al., 2015).

Figure 6. Holocene tephra in sediments on Cerro La Gloria in the city of Mendoza.

Figure 7. Sequence of five Holocene tephra in peat deposits along the Rio Atuel.

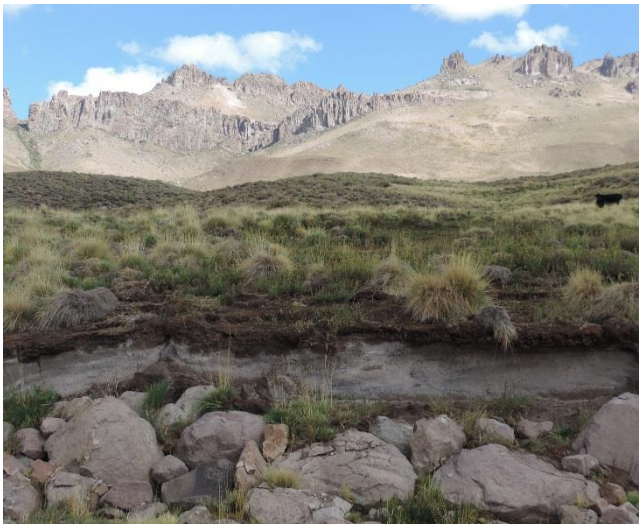

Figure 8. Fifty cm thick Holocene tephra in peat deposits east of the Puhuenche pass and Laguna del Maule.

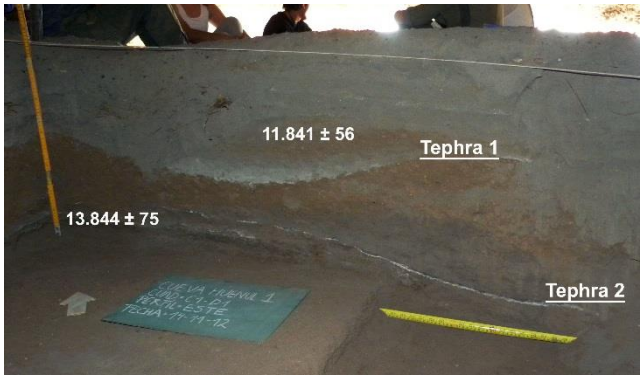

Figure 9. Holocene tephra in sediments in Huenul cave along the Río Colorado east of the Troman volcano.

3 Discussion

The tephra deposits pictured above provide evidence of late Pleistocene and Holocene volcanic activity at the northern end of the Andean SVZ. Although the chronologic and petrochemical characterization of these deposits is still in a preliminary stage, a number of significant points about this activity are clear. One is that the 450 ka eruption of the Laguna Diamante caldera was not the only large Pleistocene eruption at the northern end of the SVZ, and the city of Mendoza could be significantly affected by such eruptions if they were to occur again in the future. Second, explosive Holocene eruptions of the volcanoes near the northern end of the SVZ have produce numerous tephra deposits in the province of Mendoza that have not been previously described, and explosive volcanic activity in this part of the SVZ is likely have been similar in frequency to that further south despite the differences apparent in the most recent compilation of tephra deposits from large eruption made by Fontijn et al. (2014). Further work is required to constrain the frequency of explosive volcanic activity in this region.

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