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Upper Triassic U-Pb Age from The Agua de La Zorra Formation in Paramillos area, Mendoza Precordillera

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ABSTRACT

The Agua de la Zorra Formation (Uspallata Group) constitutes the rift infill of the Paramillos depocenter from the Cuyo basin located in the Argentine Precordillera. This unit hosts the Paramillos de Uspallata polymetallic vein-deposit. In this contribution we report a new LA-ICP-MS zircon U-Pb age of 230.2 ± 2.2 Ma (Upper Triassic) for a tuff level that belongs to the Agua de la Zorra Formation. The obtained age is consistent with the age of the volcanism in other areas of the Cuyo basin.

Key words: LA-ICP-MS in zircons; Triassic tuffs; Cuyo basin

RESUMEN

Edad U-Pb de la Formación Agua de la Zorra en el área de Paramillos, Precordillera de Mendoza.
Esta contribución reporta una nueva edad U-Pb en zircones de un nivel de tobas de la Formación Agua de la Zorra (Grupo Uspallata) que forma parte del relleno de rift triásico de la cuenca de Cuyo en el depocentro Paramillos, Precordillera de Mendoza. La Formación Agua de la Zorra aloja la mineralización de vetas polimetálicas de Paramillos de Uspallata. Los resultados de los análisis LA-ICP-MS U-Pb en circones sugieren una edad triásica superior (230.2 ± 2.2 Ma) para la Formación Agua de la Zorra. Los resultados obtenidos son consistentes con la edad del volcanismo en otras áreas de la cuenca de Cuyo.

Palabras clave: LA-ICP-MS en circones; tobas triásicas; cuenca de Cuyo

INTRODUCTION

The Paramillos depocenter is located 23 km northeast of Uspallata city in the province of Mendoza (Fig. 1a). This depocenter is part of the Cuyo basin which is interpreted to be one of several major rift basins developed during the Mesozoic (Kokogian et al. 1993, Spalletti 2001, among others) in the pre-Andean back-arc. The Paramillos depocenter infill consists of volcano-sedimentary continental sequences, named Uspallata Group (which includes Agua de la Zorra Formation), that host the Middle Cretaceous Paramillos de Uspallata Pb-Ag-Zn detachment-related vein deposit (Rubinstein et al. 2018, Orellano et al. 2020).

Geochronological studies carried out by several authors in tuffs of the neighboring depocenters indicate a Middle-Upper Triassic age for the rifting and the associated volcanism of the Cuyo basin (Spalletti et al. 2008, Ávila et al. 2006, Mancuso et al. 2010, Teixeira et al. 2018, Barredo et al. 2012). The paleofloristic studies performed by Pedernera et al. (2019) in the Agua de la Zorra Formation suggested an Upper Triassic age. According to Harrington (1971), the Agua de la Zorra Formation is correlated with the upper part of the Potrerillos Formation from the neighboring Cacheuta - Potrerillos depocenter. In this work we provide the first U-Pb zircon age of the Agua de la Zorra Formation which is discussed within the regional geologic framework of the unit.

GEOLOGICAL SETTING

The Paramillos depocenter developed over Devonian and Carboniferous sedimentary rocks (Villavicencio and Santa Helena Groups, Cuerda et al. 1993, Cortés et al. 1997) and Early Permian to Early Triassic Choiyoi Group volcanics. The Mesozoic volcano-sedimentary sequence genetically linked to the Cuyo Triassic rift basin corresponds to the Uspallata Group (Kokogian and Mancilla 1989, Fig. 1a) which includes the Paramillos, Agua de la Zorra, Portezuelo Bayo and Los Colorados Formations. These units are composed of alluvial to shallow lacustrine deposits interbedded with volcaniclastic rocks, basaltic sills and lavas (Harrington 1971). U-Pb LA-ICP-MS zircons analyses performed by Cingolani et al. (2017) in tuffs from the lower level of the Paramillos Formation yielded a maximum sedimentation age of 239.6 ± 1.3 Ma. The K/Ar whole-rock dating of basalts located in the top of the Paramillos Formation yielded ages between 235 ± 5 and 245 ± 10 Ma (Massabie 1986). The Uspallata Group is intruded by Miocene porphyries and dikes from the Cerro Redondo Formation (Cortés et al. 1997, Ramos et al. 2002, Kay and Mpodozis 2002, Fig. 1a).

The regional structure affecting the Mesozoic and Paleozoic sequence corresponds to first order N-S striking faults and second order structures such as normal faults with associated growth strata, and NW-SE and E-W strike-slip faults (Orellano et al. 2020, Fig. 1a).

Agua de la Zorra Formation

The Agua de la Zorra Formation crops out in the central part of the Paramillos depocenter (Fig. 1a). It is composed of 300 m of massive and stratified coarse-grained tuffaceous sandstones, shales and limestones (Harrington 1971, Cortés 1971). Interbedded with the tuffaceous sandstones there are massive and chaotic stratified tuffs and lapillitic tuffs which host araucaria trunks in life position (Darwin 1846, Brea et al. 2009). These tuffs show slight to moderate welding and crystalloclastic texture with ~40% of K-feldspar and minor quartz euhedral crystals up to 2 mm in length. The quartz crystals show embayments and fractures. The K-feldspar crystals are slightly to moderately altered to sericite and kaolinite. Scarce titanite and zircon crystals are also present. Abundant pumice fragments (up to 10 mm in length) and blocky shards (~45%) devitrified to quartz - K-feldspar aggregates commonly displaying axiolitic texture are also recognized. Lithoclasts are scarce (~15%) and include quartz-biotite schist and basalt fragments up to 3 mm in length. The matrix is composed by brown glass moderately altered to clay minerals. These petrographic features are similar to those described by Poma et al. (2008) for tuffs cropping out in the Darwin Forest (see Fig. 1a).

METHODOLOGY

Forty-three U–Pb zircon microanalysis were performed in sample M80 (32°28'22.2"S; 69° 9'2.1"W, Fig. 1a) located ~85 m from the base of Agua de la Zorra Formation (sensu Cortés et al. 1997). The zircon extraction technique involved crushing, milling, heavy liquids separation, hand-picking under a binocular microscope and mounting on 25 mm epoxy (SpeciFix) mounts. Mounts were polished and imaged under SEM-cathodoluminescence (CL) in a JEOL 6510 Scanning Electron Microscope at the Department of Geology (DGEO), Universidade Federal de Ouro Preto, Brazil. The analyses were carried out using a Thermo-Finnigan Element 2 sector field ICP-MS coupled to a CETAC 213 ultraviolet laser system (LA-SF-ICP-MS) at DGEO. Laser-induced elemental fractionation and instrumental mass discrimination were corrected by normalization to the reference GJ-1 608.9 ± 0.5 Ma (Jackson et al. 2004) and BB 562.9 ±1 Ma (Sláma et al. 2008). Data was corrected for background signal, common Pb, laser-induced elemental fractionation, instrumental mass discrimination using the software Glitter v. 3 (Van Achterbergh et al. 2001), and the U-Pb age was calculated using Isoplot 4.1 (Ludwig et al. 2008).

RESULTS

The analyzed zircon crystals are between 250 and 102 µm in size and show bipiramidal euhedral external morphologies

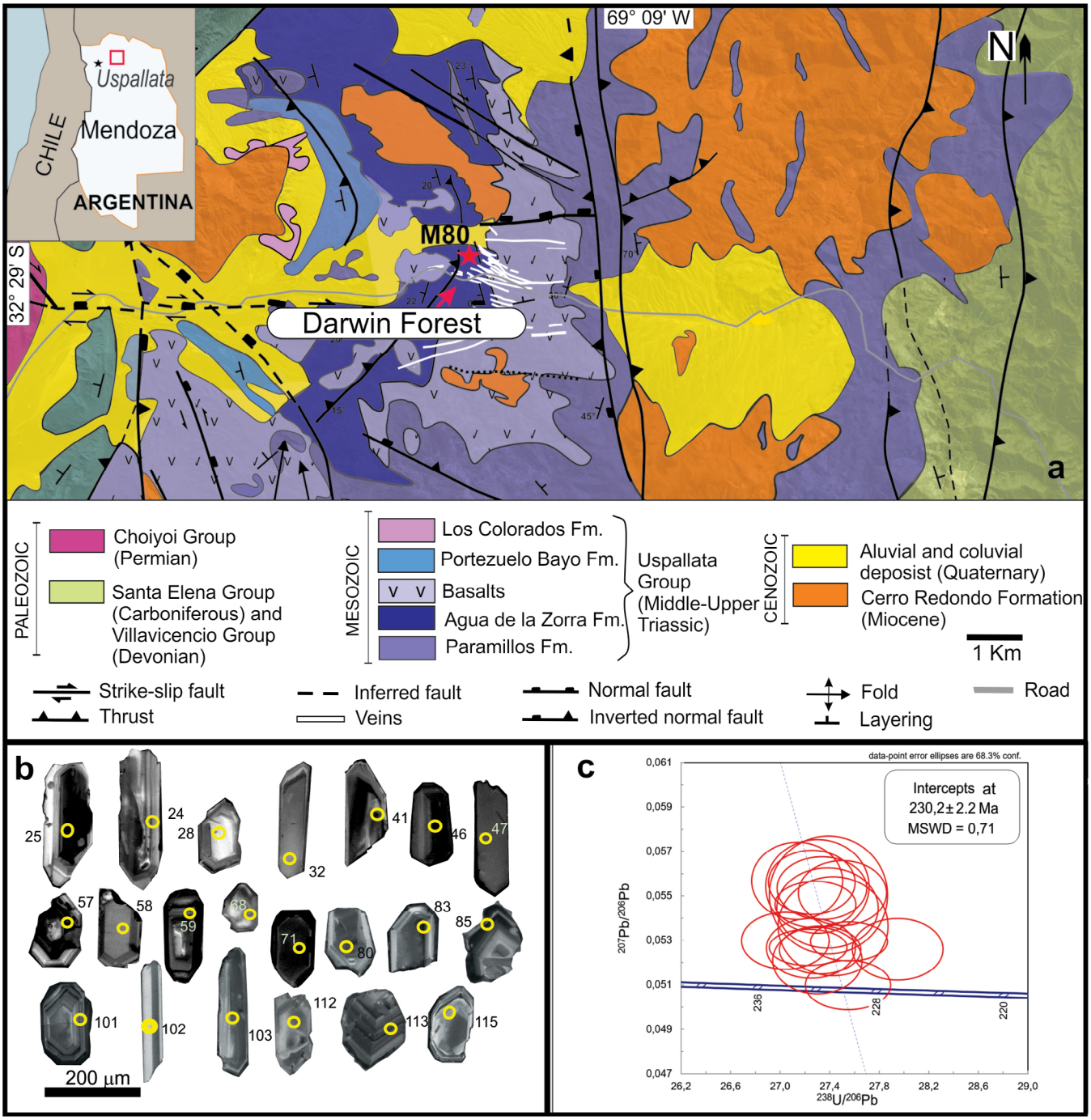

Figure 1. a) Geologic map of the study area (modified from Cortés et al., 1997). The red star indicates the location of the analyzed sample (32° 28' 22.2"S; 69° 9' 2,1"W); b) SEM-CL images of analyzed zircons of sample M80; c) Tera Wasserburg diagram of the zircon analysis of sample M80.

and zoned inner structures typical of magmatic origin (Fig 1b). However, there are some crystals with corroded and rounded edges that are likely older. Results are shown in Table 1 (Supplementary Material). The U/Th ratio < 3 is consistent with a magmatic origin (Rubatto 2002, Table 1 in Supplementary Material). The Tera-Wasserburg diagram yielded an age of 230.2 ± 2.2 Ma (n=18) which can be considered as the timing of crystallization (Fig. 1c). Moreover, five analyzes yield older ages between 543.6 y 597.6 Ma (Table 1 in Supplementary Material).

CONCLUDING REMARKS

So far, the relationship between Agua de la Zorra Formation and other Formations included in the Uspallata Group were based on relative ages and the regional correlations were poorly defined. The U-Pb age obtained in volcanogenic zircons from a tuff of the Agua de la Zorra Formation suggest an upper Triassic (230.2 ± 2.2 Ma) crystallization age for the

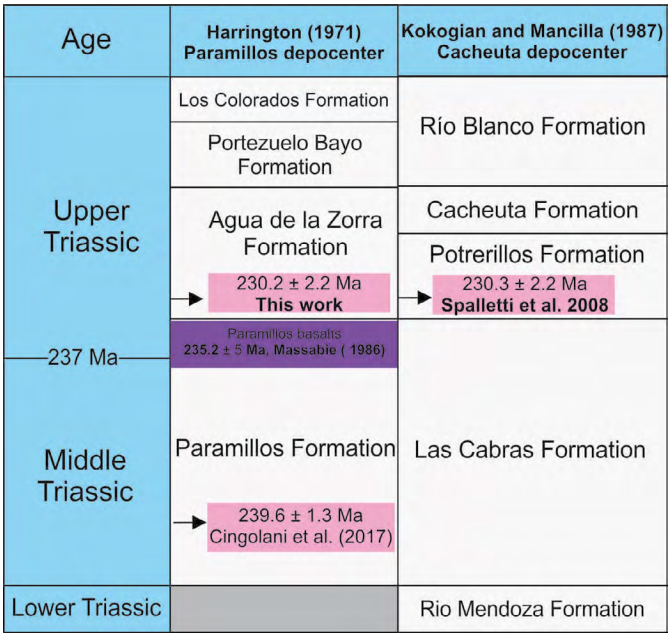

Figure 2. Triassic units in the Paramillos depocenter and its correlation with units of Cacheuta depocenter.

magmatic event. The Neoproterozoic inherited ages could be related with the assimilation of ancient basement rocks from the Cuyo basin, as is the case of the Triassic tuffs from the Cacheuta-Potrerillos depocenter (with 1000 - 1300 Ma Sm-Nd model ages) that were sourced by Mesoproterozoic rock related to the Precordillera terrane (see Ávila et al. 2006). Moreover, these inherited ages are coeval with the age of Cortaderas mafic rocks (418 ± 10 to 576 ± 17) which crop out in the Western Precordillera just to the north (Davis et al. 2000 and references therein).

The age obtained for the Agua de la Zorra Formation is consistent with the maximum age of sedimentation of the underlying Paramillos Formation, 239.6 ± 1.3 Ma, obtained by Cingolani et al. (2017). Moreover, this new age correlates with the effective age of sedimentation obtained for the upper section of Potrerillos Formation in the Cacheuta-Potrerillos depocenter (230.3 ± 2.3, Spalletti et al. 2008) supporting the correlation suggested by Harrington (1971) (Figure 2). These results allow calibrating the temporal relation between Uspallata Group units contributing to a more accurate correlation of the Triassic sedimentary sequences and suggest that the Upper Triassic volcanism was coeval in the different depocenters of the Cuyo basin.

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