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Peperite formation during a phreatomagmatic eruption at Cerro Tujle volcano, northern Chile

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Cerro Tujle is an isolated maar located in the Central Volcanic Zone in northern Chile. This maar is situated 21 km to SE of the Salar de Atacama Basin at 3,554 m a.s.l. at the top of the Cordón de Tujle anticline. This area is characterized by a thick-skinned deformation dominated by a series of NS-trending fault propagation folds and fault-bend folds with asymmetrical E vergence. Morphologically Cerro Tujle maar presents an elliptical crater (333 m across E-W and 279 m across N-S) surrounded by tephra deposits with an estimated erupted bulk volume of 0.024km^3. The erupted material mainly corresponds to andesites with aphiric texture and lithic xenoliths of acid composition, which lies over the Tucúcaro Ignimbrite that covers the whole area. Theses lavas can be separated at least in two types, 1) a brown-red andesite that is located at the north-northwest flank of the crater and 2) underlying black andesites, which surround the crater. A localized domain of magma and sediment mingling occurs at the base of the brown-red andesite showing textural evidence of partial fluidization and vesiculation of the sediment. It also shows globular style contact texture with a coarse-grained volcanoclastic bed. These texturally mixed rocks have been interpreted as peperites that have been described as intruding or invading magma into an unconsolidated wet host sediment, which has been found at the base of the brown-red lavas. On the other hand, in these rocks breccias of black andesite fragments and acid clast have also been recognized. Acid clasts correspond to rhyolitic composition lithic xenoliths, which present disequilibrium textures as breakdown rim width with skeletal and sieve textures. Additionally, pumice clast and devitrification structures have also been noted. These characteristics suggest decompression processes from shallow reservoirs with multiple magma batches and extensive fine scale magma mixing and mingling during magma ascent. Hence, magma would have been channeled from fault plane migrating quickly toward the surface along compressional tectonic regime, resulting in a non-explosive and explosive mixing where it also interacted with groundwater near the surface, recording a stepwise vertical mixing of lithic xenoliths and juvenile material by upward-directed debris jets. The presence of peperites could suggest a period of reduced magmatic output allowing coarse mixing with the unconsolidated shallow lithologies during the phreatomagmatic eruption.