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The flow-banded rhyolite dome of San Bartolomé (Alcoroches, Guadalajara), a novelty for Spain

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Abstract

In the Keltiberian Massif of Nevera (SE Guadalajara, Spain) a Permian endogenous dome of flow-banded felsophyric rhyolite is recognized. Polymict, poorly-sorted, matrix-supported pyroclastica along the vent of the body indicate a gas-rich blow-out prior to its emplacement. The breccias comprise, besides fragments of Paleozoic sedimentary country-rock, porphyritic phenodacite and phenoandesite, indicating the existence of less differentiated calc-alkaline subvolcanic rock in the underground.

Geological setting

In the Keltiberian Chain at the NE margin of the Mesozoic cover of the Variscan Iberian Massif, NW-SE trending horsts form ridges of Variscan deformed Paleozoic siliciclastic sequences and Stephano-Autunian, calc-alkaline volcanics (Hernando 1980; Navidad 1983). The volcanics were emplaced in the period between a compressive phase and the late-Hercynian intraplate continental distension (Lago et al. 1988; Torres et al. 1989). The Variscan ridges of the Keltiberian Chain in the Sierra de Albarracín (Fig. 1) comprise the Macizo del Tremedal, with dacitic intrusions and volcaniclastic deposits (Riba 1959; Trurnit 1964), and the Macizo de Nevera, where the rhyolite described in this paper occurs.

To our knowledge, this is the first description of a rhyolite dome in Spain. The exposure, at 2 km SW of Alcoroches in the east of Guadalajara province, measures about 750 m N-S and 500 m E-W. The body cuts across a north-trending Variscan anticline of Silurian and Ordovician slates, silts and psammites. In the north, the steep banding in the rhyolite is cut off and overlain by red conglomerate and sandstone of the Late Permian and Early Triassic Buntsandstein (Pérez-Arlucea & Sopeña 1983; Ramos et al. 1986). Up to a few metres below the Buntsandstein, the brownish rhyolite shows red impregnation. Pebbles of rhyolite occur in the Buntsandstein near Bronchales, 15 km to the SE. Near Bronchales, dacites abound, but rhyolite is absent. Paleocurrents in Scythian Buntsandstein sediments corresponding to the upper cycle of the Hoz del Gallo Conglomerate (Ramos et al. 1986) suggest SE-ward transport of rhyolite pebbles from the Alcoroches locality.

The relative age of the rhyolite (post-Variscan, pre-Buntsandstein) is in accordance with the Stephano-Autunian age of the magmatism in the Keltiberian range (Navidad 1983).

Field observations

The finely banded light-brownish volcanite shows mm-size euhedral and broken phenocrysts of bipyramidal quartz and of feldspar. Lithophysae are

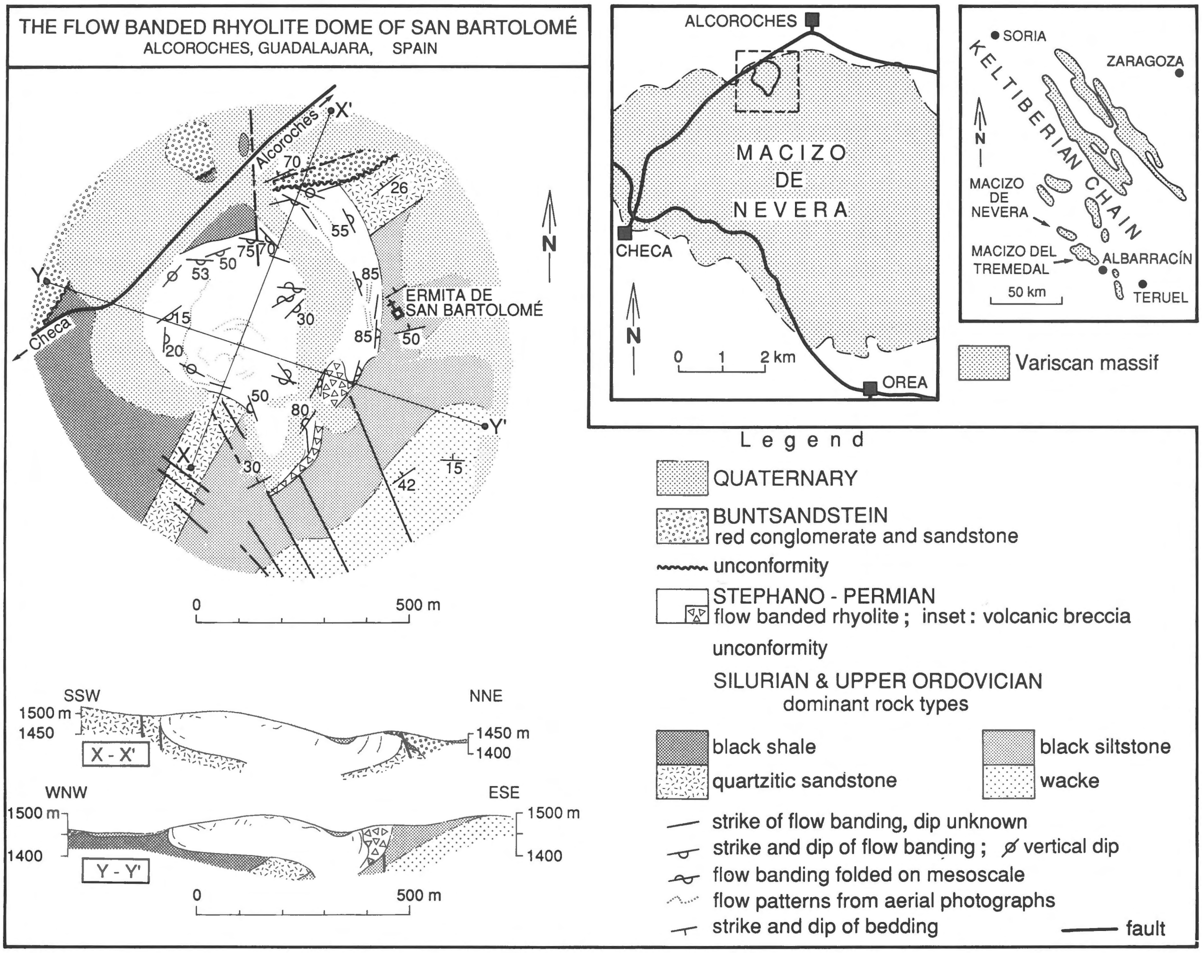

Fig. 1. Geological map and cross sections of San Bartolomé rhyolite dome in the Variscan Macizo de Nevera, Keltiberian Chain.

absent. The outer zone of the body shows steep flow banding parallel to the contacts; in the central parts flow directions vary; some details from aerial photographs are shown in Fig. 1. In the centre of the body micro- and meso-scale disharmonic, variably oriented, asymmetric flowage folds are common (Figs 2, 3), but faults are absent.

The cross sections in Fig. 1 portray the dome structure indicated by the contacts and flow banding.

At the SE of the body is a tens of metres wide zone of polymict, poorly-sorted pyroclastic breccias (Fig. 4) and lapilli tuffs. The pyroclastic fragments comprise quartz-porphyritic light-coloured phenorhyolite, and feldspar-quartz and feldspar-porphyritic phenodacite and phenoandesite showing a greenish matrix. Also present are appreciable amounts (<25%) of angular fragments of Paleozoic country rocks (slate, silt, wacke, quartzitic sandstone and vein quartz). The latter are of mm- to cm-size, though 5 cm-large fragments also occur; the pyroclastic fragments vary in size from 0.5 to several cm and occasionally 20 cm. The larger fragments are supported by finer-grained matrix. Dragging of flow banding along the sides of the rhyolitic fragments indicates that these rocks were deformable and very hot during their transport.

Autoclastic monomict breccias, a carapace of brecciated pumice, aprons of talus blocks and secondary, fragment-supported breccias or tuffs have not been found.

Fig. 2. Meso-scale flowage folds in rhyolite.

Petrography

The volcanite has a felsophyric structure with about 5 vol.% phenocrysts, more than half of which are 1–2 mm, euhedral, bipyramidal quartz crystals showing corrosive embayments. Rather fresh, mm-size, Karlsbad-twinned, euhedral sanidine crystals make up 0.5 to 1 vol.%; a low-temperature structure is indicated by the optical properties $2V_{\alpha} \approx 30°$ and O.A.P. $\perp$ (010). Less than 0.5 vol.% of biotite occurs in mm-size flakelets with opacitic rims. Some samples contain less than 1 vol.% oligoclase in 1 to 1.5 mm, often strongly sericitized, euhedral crystals showing albite and

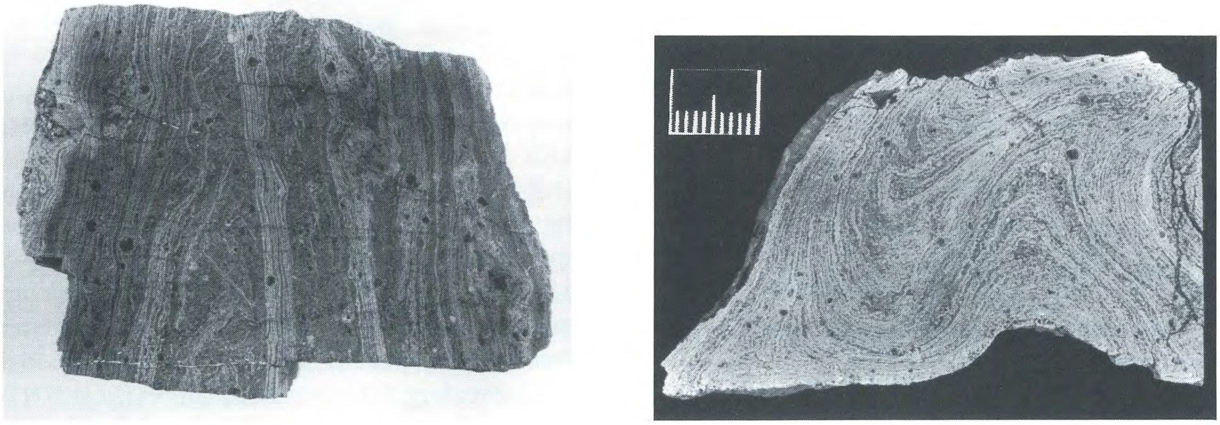

Fig. 3. Polished sections of flow-banded felsophyric rhyolite showing fine banding, wrapping around euhedral quartz phenocrysts (a), and complex flowage folding (b). Scale bar is 1 cm and applies to both photographs.

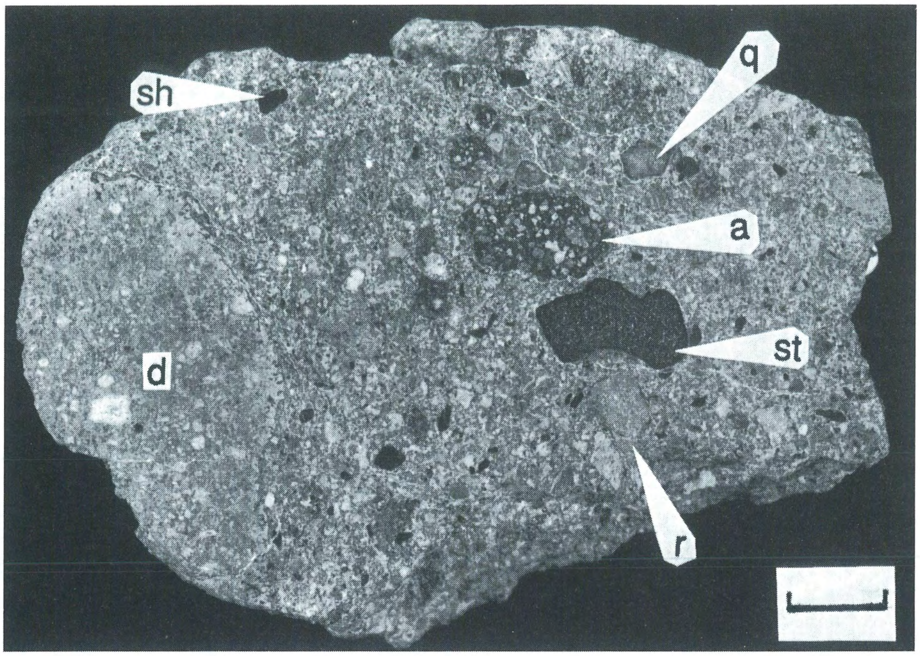

Fig. 4. Polished section of polymict, ill-sorted, matrix-supported, pyroclastic breccia, containing fragments of felsophyric rhyolite (r), plagioclase-porphyritic dacite (d) and andesite (a), silt (st), shale (sh) and quartzitic sandstone (q). Scale bar is 1 cm.

Karlsbad twinning. Based on its content of phenocrysts the rock is a phenorhyolite. The clay-altered matrix contains relicts of spherulites and axiolites, suggesting devitrification of a glassy texture. A fine flow structure of 0.4 to 2 mm-thin bands, accentuated by differences in redbrown colour and streaks of biotite, wraps around the phenocrysts. Lithophysae have not been found.

In the pyroclastica, plagioclase phenocrysts of dacitic and andesitic fragments are almost completely replaced by clay minerals, but still reveal their original character by the textural relicts of the albite-Karlsbad twinning. Felsite fragments are phenorhyolite as they contain euhedral or magmatically corroded and broken quartz phenocrysts and occasional sanidine phenocrysts. Spherulites and axiolites in felsite fragments are strongly altered into aggregates of clay rimmed by quartz.

Fragments of strongly re-crystallized wacke show abundant 'tourmaline suns'.

Discussion and conclusions

The flow-folding and absence of syn-flowage faulting suggest plastic flow without brittle behaviour. Such a flow requires a viscosity of 10^7–10^9 $gcm^{-1}s^{-1}$, which is possible for rhyolitic magma of very low fluid content at temperatures above 750° C (Fink 1983). The paucity of volatiles is suggested by absence of lithophysae.

The poorly sorted, angular, matrix-supported and polymict fragments in the pyroclastic rocks indicate an explosive origin. This and tourmalinization of pyroclastic fragments provide evidence for a high content of volatiles in a previous stage, prior to the explosive magma blow-out that was followed by the rise to the surface by plastic flow of degassed, bubble-free, felsic magma (epimagma) of low viscosity. A Paleozoic quartzitic sandstone layer, several tens of metres thick, was broken through, presumably by the explosive, gas-rich blow-out along the pre-existing late Variscan NNW faults that offset Paleozoic silts and wackes (Fig. 1). Apparently, a substantial volume of Paleozoic country rocks was fragmented, blown-out and spread over the surroundings by the explosion; a part of the blown-out fragments fell back into the crater and formed a layer on the rising, felsic magma dome. Pre-Buntsandstein and presumably also later erosion have removed the pyroclastic cover deposits and parts of the rhyolite as well, thus exposing the breccias and tuffs in the wall of the vent. The flow pattern indicates plastic behaviour and slow cooling of the dome. An autoclastically fragmented crust of a subaerial dome may have been removed by pre-Buntsandstein erosion. However, as depicted above, we are probably dealing with a subvolcanic intrusion into the pyroclastic products of a preceding explosive stage from the same vent.

In the Macizo del Tremedal, Permian dacitic volcanism has been mainly explosive; near Bronchales in the same Macizo, Paleozoic quartzites, bordering dacitic intrusives, are strongly brecciated and tourmalinized. Dacitic rocks are not exposed in the Macizo de Nevera, but their occurrence in the underground is suggested by dacite and tourmalinized wacke fragments in the pyroclastic breccias of vent walls.

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