

New indirect evidence of Permian bi-modal volcanism from sediment petrology in the Orobic Basin (Central Southern Alps, Italy)

Reguzzi S.*¹, Chesi C.¹, Strepparola L.¹, Cadel G.², Berra F.¹ & Felletti F.¹

¹ Università degli Studi di Milano, Dipartimento di Scienze della Terra “A. Desio”

² Petroleum Basin Analyst - Vidigulfo PV

* Corresponding email: simone.reguzzi@studenti.unimi.it

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The Lower Permian Cабianca Volcanite (lower Collio Fm. *Auct.*), representing the filling of a large caldera, is dominantly acidic, as most coeval volcanics in the Southern Alps: intermediate rocks are rare and nearly irrelevant by volume (only two small andesite breccia pipes outcrop on the flanks of Mt. Cабianca). Subsurface data document the occurrence of an andesite body in the Novazza mine and a diatreme 2 km to the east (crossed by a prospecting well), on the left Serio River valley. Out of the moat, Lower Permian pyroclastics outcrop along tens of kilometres, but intermediate rocks are unreported, except for the Val Pradini “porfirite amigdalare” in the west (Ornica). Permian volcanics and Variscan metamorphics are covered by Lower Permian sediments deposited in a transtensional basin, bound by steep faults and fringed by alluvial fans. The alluvial fan conglomerate of Val Sanguigno, north of Novazza, is dominated by andesitic clasts (cobbles-boulders), which reasonably derived from lavas that were outcropping beyond the southern boundary fault of the basin.

Investigations of the petrographic composition of the alluvial fan conglomerates carried out east and west of Mt. Cабianca, allowed comparing the composition of the volcanic rocks preserved in the depocentre (Cабianca Caldera) with the volcanic rocks cropping out outside of it, recorded in the clasts of the alluvial fans at the borders of the Orobic Basin. In the eastern (Lake Barbellino) and central (Val Sanguigno) parts of the basin, conglomerates at the southern border of the basin contain abundant intermediate pebbles, and an increasing proportion of basement clasts to the west. Conglomerates from the northern margin of the basin (Ponteranica Conglomerate, Pizzo dei Tre Signori massif) mainly contain pebbles and cobbles of metamorphic basement, acidic welded tuffs and, subordinately, of grey-green volcanics. In both cases, microscope analysis of associated litharenites revealed significant quantities of intermediate to basic volcanic lithic fragments. Visual estimates suggest that basic to intermediate clasts represent 15 to 20% of the bulk volume.

Petrographic composition of Lower Permian conglomerates confirms that Permian streams eroded both volcanic rocks and the Variscan basement, but documents that in the source area of the siliciclastics (i.e. highs bordering the basin) intermediate-basic volcanics were more abundant than in the Cабianca Volcanite. The relatively scarcer acidic pebbles in the conglomerate can be partly ascribed to the fact that they were still incoherent and reluctant to produce pebbles transportable over significant distance. Nevertheless, the high amount of basic-intermediate rocks documents that outside of the caldera these rocks were volumetrically abundant. This fact may be explained suggesting the existence of fractures and faults able to drive and trap basic-intermediate lavas documenting a clear bi-modal distribution of extrusives at the surface.