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New geochronological constrains in the Orobic Alps: a proxy for Late Cretaceous and Eocene compressions in the central Southern Alps

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The Orobic Alps are exposed between the Adamello batholith to the east and the Como Lake to the west. They include a nearly complete crustal section comprising a Variscan basement and its overlying Permian-Mesozoic sedimentary cover, which experienced severe shortening by folding and thrusting during the Alpine orogeny (Laubscher, 1985; Schönborn 1992b; Carminati & Siletto, 1997). The timing of Alpine deformation in this area still represents a matter of debate, since the lack of reliable absolute time markers has hampered, so far, a precise chronological reconstruction of the evolution of the Orobic belt.

In the northern sector of the Orobic Alps, the Orobic Thrust and the Porcile Thrust represent first-order geological structures along which the basement overrides the sedimentary cover. The occurrence of pseudotachylytes (Carminati & Siletto, 2005; Meier, 2003) within both fault zones in the Passo San Marco – Laghi di Porcile area, offers the opportunity to obtain absolute age determinations of the main compressive phases recorded along these structures. New 40Ar/39Ar data on pseudotachylyte veins, obtained by means of furnace stepwise-heating experiments, yielded two age clusters of Late Cretaceous and early to middle Eocene age both along the Porcile and the Orobic thrusts. These coexisting pseudotachylyte ages suggest that the Alpine evolution of the Orobic Alps can be correlated to a long-lasting compressive deformation history pre-dating the Adamello intrusion. 40Ar/39Ar data suggest that this pre-Adamello deformation was polyphasic, probably subdivided in two main periods, each of them with a minimum duration of 10-15 Ma. These data provide the first direct evidence of a Late Cretaceous tectonic activity in the Orobic Alps, previously envisaged only on the base of the presence of the Cenomanian to Maastrichtian Lombardian flysch (Doglioni & Bosellini, 1987) deposited in the E-W trending foredeep at the southern edge of the growing orogenic wedge. New U-Pb zircon ages, on different sets of andesitic dykes cross-cutting the Alpine thrusts, provide additional time-markers for the evolution of the belt. South of the Clusone Fault, in the area between Gandino and Sovere (BG), thrusts surfaces developed in the Triassic succession during two distinct events, are cut by E-W normal faults along which several andesitic dykes and a small stock are intruded. Dykes preferentially follow the main normal faults and are not deformed by compressive structures, suggesting that they were emplaced after the main thrusting stages at the end of normal faults activity. North of the Clusone Fault, dyke swarms cross-cut thrust surfaces in the Upper Triassic units of the Presolana antiformal stack (Zanchi et al., 1990a; Fantoni et al., 1999). U-Pb zircon analyses indicate middle-late Eocene magmatic ages both for the Gandino and the Presolana dykes, suggesting close time relationships between the earliest Adamello intrusion stages and the widespread dyke magmatism recognized in the Orobic Alps. Apatite fission-track analysis point to emplacement of these dykes at very shallow crustal levels, in country rocks already located above the partial annealing zone of apatite. This demonstrates that the central sector of the Orobic belt were already structured and largely exhumed in middle Eocene.