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Superposed Sedimentary and Tectonic Block-In-Matrix Fabrics in a Subducted Serpentinite Mélange (High-Pressure Zermatt Saas Ophiolite, Western Alps)

Paola Tartarotti [1,*], Sara Guerini [1], Francesca Rotondo [1], Andrea Festa [2], Gianni Balestro [2], Gray E. Bebout [3], Enrico Cannaò [1,4], Gabe S. Epstein [3] and Marco Scambelluri [5]

1 Dipartimento di Scienze della Terra, Università degli Studi di Milano, via Mangiagalli 34, 20133 Milano, Italy
2 Dipartimento di Scienze della Terra, Università di Torino, Via Valperga Caluso 35, 10125 Torino, Italy
3 Department of Earth and Environmental Sciences, Lehigh University, Bethlehem, PA 18015, USA
4 Istituto di Geoscienze e Georisorse, CNR, Via Moruzzi 1, 56124 Pisa, Italy
5 Dipartimento di Scienze della Terra Ambiente e Vita, Università di Genova, Corso Europa, 26, 16132 Genova, Italy
* Correspondence: paola.tartarotti@unimi.it

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Abstract: The primary stratigraphic fabric of a chaotic rock unit in the Zermatt Saas ophiolite of the Western Alps was reworked by a polyphase Alpine tectonic deformation. Multiscalar structural criteria demonstrate that this unit was deformed by two ductile subduction-related phases followed by brittle-ductile then brittle deformation. Deformation partitioning operated at various scales, leaving relatively unstrained rock domains preserving internal texture, organization, and composition. During subduction, ductile deformation involved stretching, boudinage, and simultaneous folding of the primary stratigraphic succession. This deformation is particularly well-documented in alternating layers showing contrasting deformation style, such as carbonate-rich rocks and turbiditic serpentinite metasandstones. During collision and exhumation, deformation enhanced the boudinaged horizons and blocks, giving rise to spherical to lozenge-shaped blocks embedded in a carbonate-rich matrix. Structural criteria allow the recognition of two main domains within the chaotic rock unit, one attributable to original broken formations reflecting turbiditic sedimentation, the other ascribable to an original sedimentary mélange. The envisaged geodynamic setting for the formation of the protoliths is the Jurassic Ligurian-Piedmont ocean basin floored by mostly serpentinized peridotites, intensely tectonized by extensional faults that triggered mass transport processes and turbiditic sedimentation.

Keywords: sedimentary mélange; broken formation; ophiolite; Zermatt Saas; turbidite

1. Introduction

In most orogenic belts and exhumed subduction-accretion complexes around the world, a strong morphological convergence of meso- to map-scale fabrics exists in the block-in-matrix fabric of different types of mélange (i.e., sedimentary, diapiric, tectonic, and polygenetic mélanges) [1–3]. This close resemblance has led to a long-standing debate on the nature and mode of geological processes (i.e., gravitational vs. tectonics), that lead to the formation of chaotic rock assemblages, particularly in areas of well-preserved, exhumed subduction-accretion complexes such as in the Western US Cordillera, the Circum-Pacific Region, and Circum-Mediterranean Region [1–20]. In fact, the mechanisms responsible for the formation of mélanges may occur in a wide range of geological settings, ranging from relatively shallow to deep crustal levels [7,21]. Thus, the ongoing debate revolves