



Sedimentology of the Larissa ophicalcrite breccias: Mass flow deposits in a Tethyan Ocean-Continent Transition zone

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The ophicalcrite breccias in the Larissa area, Central Greece, comprise part of the Eohellenic nappe that overthrusts the Pelagonian Zone and which represents a Mesozoic continental fragment of Gondwana. They are enveloped by imbricated serpentinites that overlie amphibolite and greenschists and structurally underlie crystalline limestones of the Upper Cretaceous age. Although these breccias have suffered hydrothermal and/or low grade metamorphism, most of their original sedimentary structures have been remarkably preserved, thus providing valuable information about their depositional conditions and mechanisms.

The ophicalcrite breccias consist primarily of serpentinite and secondarily carbonate clasts. Some of various dispersed clasts, which are composed of gneissic rocks, granite together with a few fossiliferous carbonates, are considered as belonging to the Pelagonian continental basement. The matrix percentage ranges widely resulting in the development from grain-supported fabrics with clasts cemented by sparry calcite to matrix-supported fabrics, where the clasts are embedded in a light green to brownish/red matrix made of serpentinite, calcite and some iron oxides.

Though the ophicalcrite breccias give the overall appearance of being structureless and disordered, nevertheless, the local presence of particular primary and diagenetic structures combined with essential changes in the distribution of the components throughout the formation have led to the identification of three distinctive units showing evidence of deposition by different gravity-induced mass flow processes. Accordingly, in the lower unit observation has been made of repeated alternations of finer- and coarser-grained beds with thickening- and coarsening-upward organization and clear reverse grading of their constituents in the latter, indicating that they were deposited by sediment gravity flow processes and specifically grain flows. In the intermediate unit comprising the major part of the breccias, the chaotic aspect in association with the extremely poor sorting and the almost exclusive predominance of clast-supported fabrics together with the presence of some non-oriented geopetal structures lend support to their characterization as rockfalls. The few very large white marble blocks located in this unit are interpreted as single olistoliths. On the other hand, the occurrence of a very small quantity of cobble-sized bioclastic carbonate clasts is notable since they obviously originate from the margin of the Pelagonian platform, as indicated by their large benthonic skeletal fragments. Additionally, this unit is characterized by the extensive development of a variety of fractures and fissures, from very thin and simple to thick and composite, as well as common intergranular cavities. All these are filled with calcite and/or early diagenetic and often laminated internal sediment comprising alternations of carbonate and serpentinite material. The upper unit, which contains a significant amount of reworked clasts derived from the underlying unit, comprises debris flow deposits judging from the great amount of matrix, the typical absence of internal organization, the poor sorting and their intense erosional lower surface.

Finally, the ophicalcrite breccias under study show a highly complicated tectono-sedimentary origin as is documented in particular by the polygenetic nature of the many fracture fillings and the repetition of the resedimentation processes, while the hydrothermal activity seems to have enhanced their lithification from the very earliest diagenetic stages. Furthermore, the predominance of the primary two types of resedimented deposits is indirect evidence of the occurrence of a steep slope as well as a short distance of transportation of their component from the source. Overall, it could be deduced that the Larissa ophicalcrite breccias formed atop an exhumed lithospheric mantle in a rift-related ocean-continent transition zone between the eastern continental Pelagonian margin and the Vardar Ocean, probably taking place during the Jurassic.