Olistostromes of the Pieniny Klippen Belt, Northern Carpathians

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The existence and transformation of the accretionary wedge in the Carpathians are documented by occurrence of olistostromes. The size of olistoliths varies, from centimeters to kilometers. Very large blocks could slide independently into the Carpathian basins, unaccompained by easily distinguishable matrix. The matrix in presented case is the flysch sequence or even entire sedimentary-tectonic unit. Olistostrome bodies form two belts within the Pieniny Klippen Belt in Poland and Slovakia and mark an early stage of development of the accretionary prism. The first belt was formed during the Late Cretaceous as a result of subduction of the southern part of the Alpine Tethys. A fore-arc basin originated along the subduction zone with synorogenic flysch deposits known under different names: Złatne, Klape, Drietoma, Myjava or Manin Succession. Huge olistoliths deposited within the Cretaceous-Paleogene flysch of the Złatne Successions in the vicinity of Haligovce village (eastern Slovakia). They contain the Middle Triassic-Lower Cretaceous sequence of carbonates and siliceous rocks. In Slovakia, the fore-arc olistostromes belong to the so-called peri-Klippen zone. Huge olistoliths of Triassic – Lower Cretaceous carbonates were deposited within Klape and Manin Cretaceous-Paleogene flysch ("wildflysch") sequences in the Považie area. The largest olistolith occur in Butkov and Manin. Narrow carbonate platforms originated along the margin of the fore-arc basin during the Paleocene times. Within these platforms complex reef systems developed (so-called Kambühel limestones). Large fragments of these reefs occur in Haligovce, Vélký Lipník and in Považie area in the Pieniny Klippen Belt in Slovakia forming olistoliths within flysch deposits of the Žilina Formation.

The second belt is related to a movement of the accretionary prism, which overrode the Czorsztyn Ridge during the Late Cretaceous-Paleocene. Destruction of this ridge led to formation of submarine slumps and olistoliths along the southern margin of the Magura Basin (Outer Flysch Carpathian basin). This olistostrome belt is well developed in the Polish sector of the Pieniny Klippen Belt at its border zone with the Magura Nappe. The olistoliths and large clasts are represented by igneous rocks (including basalts) as well as a variety of carbonate rocks of the Triassic - Cretaceous age representing the Alpine Tethys basinal and ridge sequences as well as the Inner Carpathian terrane sequences. The large Homole block in Jaworki Village is an olistolith. The famous tectonic fold and thrust structures, that originated due to slumping, can be observed in the Czajakowa Skała Klippe in the upper part of the Homole Gorge where the Niedzica Nappe is thrust over the thick Czorsztyn Unit. Carbonates and radiolarites of the Niedzica Succession, which were originally deposited on the southeastern slope of the Czorsztyn Ridge form a submarine slump emplaced on the Czorsztyn Succession, originally deposited in the central part of the ridge. The Biała Woda basalt klippe near Jaworki also represents an olistolith probably derived from the Czorsztyn Ridge. Between Krościenko and Polish-Slovak border the Magura olistostromes contain a variety of various successions representing ridge and slope facies of the Czorsztyn Ridge. Famous Sobótka Klippe below the Czorsztyn Castle and Rogoża Klippe (near Rogoźnik) represent the Czorsztyn Succession deposited on the axial zone of the ridge. Large Zawiasy and Łupisko olistoliths belong to the so-called Branisko Succession deposited on the northern slope of the Czorsztyn Ridge. Numerous small olistoliths like Tylka or Stare Bystre represent different transitional successions deposited between the ridge and a slightly deeper transitional zone. It is thought that at many localities (e.g. between Szaflary and Stare Bystre in Poland or in Eastern Slovakia the Pieniny Klippen Belt is represented entirely by the Złatne and Magura parts of the accretionary wedge with olistoliths embedded in the flysch sequences. Some klippen surrounded by the Magura flysch in Orava and Považie region in western Slovakia may represent olistoliths as well. There is also a possibility of olistolithic origin of some klippen in the Magura flysch in eastern Slovakia sector of the Pieniny Klippen

Belt. It is also considered that numerous klippen surrounded by the Magura flysch in Orava and Považie region in Slovakia may represent olistoliths. Also possibility of occurrence of olistoliths in the Ukrainian and Austrian sectors of the Pieniny Klippen requires further research.

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Effects of high temperatures in building granites: micro-cracking patterns and ultrasound velocity attenuation

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Fire is one of the most important catastrophic decay agents of building stone because of the severe mineralogical and physical modifications that generates within them. Fire causes decay due to the heat and the solid fraction contained in the fumes produced during fire. The impact of these two components is different depending on the location of stone in relation to fire. However, in low porosity, dense materials the effects of heating can easily override those of the fumes. Accordingly to this, granite will be, during a fire, mostly affected by the quick heating and the high temperatures reached, and experience physical breakdown due to the micro-cracking generated by the differential thermal expansion of minerals. Especially, in granites, cracking will occur if the thermal gradient is higher than 2ºC/minute. The very low initial porosity favours this process due to the dense packing of minerals with different thermal and structural properties in the stone.

The aim of this research is to characterize the micro-cracking patterns of granites, commonly used internationally as building stone, when heated in furnaces to temperatures ranging from 100 to 900ºC, simulating the temperature increase that these materials could undergo during a fire. Thirteen building granites were selected on the basis of their petrophysical characteristics, such as grain size, mineral grain size ratio, mineral anisotropy, mineral composition and porosity. Some of them also showed prior cracking. Non-destructive methods were used to characterize the changes at different temperatures within this range. This allows repeated measurement in the same samples before and after being exposed to high temperatures. This methodology was also selected as it can be used for the on-site characterization in heritage buildings without sampling and allows comparing the laboratory results to real fire damage found in buildings. 3-D topography was used to evaluate surface changes and it was measured by means of a TRACEiT® Portable Optical Surface Analyser and a Leica confocal binocular microscope with stereoscopic software. Variations in roughness parameters evidence damage patterns. In polymineral rocks, such as granites, each mineral behaves in a different way when exposed to weathering agents. Average roughness gives an indication of surface variations, but in this case, peaks or valleys provide more information on the damage processes. Peaks represent minerals pulled out due to the expansion and the internal pressure generated. Valleys correspond to cracks and the measurements before and after the tests show differences in their deepness and quantity. Ultrasound propagation velocity (Vp) as well as ultrasound attenuation was measured with a CNS Electronics Pundit tester with an attached Tektronix oscilloscope. This research also analyzes the advantages and shortfalls of these techniques and parameters to evaluate fire decay.

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