

Silicification of the Upper Jurassic (Oxfordian) deposits of Kraków area

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The area of Kraków is located in southern Poland, in the most southern part of the Kraków-Częstochowa Upland. It mainly consists of Oxfordian limestone of three structural types: platy limestone, bedded limestone and massive limestone. Also certain types of silicification have been found in that rocks, especially cherts are commonly found in the bedded limestone. Silicification was mainly described during other lithological studies, barely in a separate paper and individual researchers have used different nomenclature and divisions. Rajchel (1971) collected the summary of the current knowledge on the Oxfordian silicification, however, by introducing their own names. Nevertheless, several common types of silica can be described in deposits of the Krakow area:

A) Cherts – the most common type of silica present in bedded limestone. They occur as siliceous nodules with sharp boundaries, their typical features are the absence of porosity, chocolate, dark-brown or gray color, diameter < 15 cm and a crystallinity index of < 1. Cherts appear in interlayered horizons (Matyszkiewicz, 1989; Matyszkiewicz, 1996) or completely chaotic. This may be related to the presence of primary clay mineral horizons, where silica has formed concretions. That kind of silicification represents early diagenetic changes and their origin is connected to pH changes. Sponges rot in anaerobic conditions (results of sulphides from seawater reduction) and can be a reason for pH increase and the dissolution of silica. Spicules of the sponges are probably the main source of the silica (Pawlikowski *et al.*, 1978).

B) Silicified limestone – occurs inside bedded limestone as layers of about 0.4 m thickness and a length of up to several meters, it is characterized by sharply separated zones of silicification and the presence (or absence) of carbonates and a crystallinity index ~5.1. The origin of this type is probably also early diagenetic.

C) Irregular nodules – Alexandrowicz (1960) described a rare, small, porous, gray, irregular concentration of silica of unknown origin, which presents in the rock together with common chert (Matyszkiewicz, 1989). They can be seen on the erosion prepared surfaces or by dissolving the rock samples with a hydrochloric acid.

D) Epigenetic Silicification – presents in almost all Kraków area outcrops. Mainly regardless of lithology, it occurs in the top of the Upper Jurassic deposits. This type is porous, gray or pale brown, always has unequivocal boundaries with the surrounding rock. In this case, the limestone is hydrothermally replaced (Rajchel, 1971; Matyszkiewicz, 1987) by silica (90%). Very high degree of crystallinity is common, in the range of 9.2 to 9.9 (Matyszkiewicz, 1987), suggesting a total lack of chalcedony and opal. The time of replacement is unknown, probably younger than Santonian (Alexandrowicz, 1958). The source of the silica is also not exactly known. It could be the dissolution of spicules (Alexandrowicz, 1958) or the primary component of the hydrothermal solution (Matyszkiewicz, 1987).

Geological fieldwork took place in the Piekary outcrop, where the rock wall height is about 16 metres. In the northern part of the quarry occurs the bedded limestone with clearly visible 0.9-2.5 m thick layers with flints, while in the southern part massive limestone occurs.

Quantitative research shows that the bedded limestone contains up to 6.5 % chert and circa 8.33 % of sponge skeletons. As a contrary, massive limestone contains only 7.33 % of sponge skeletons.

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