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Storm wave deposits in southern Istria (Croatia)

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The accumulation of large boulders related to extreme waves are well documented in different areas of the Mediterranean coasts, such as in Turkey, Algeria, Egypt, Greece (Lesbos and Crete islands), France, Spain, Malta, Italy (Sicily and Apulia regions). These deposits have been associated to storm or tsunami events or both, depending on the local history. If compared to the Mediterranean Sea, the Adriatic Sea is considered a shallow basin, with very low wave energy. In particular the NE Adriatic, where Istria Peninsula (Croatia) is located, geological and geomorphological evidences of extreme wave events have never been described, as well as no tsunamis have been registered.

We present the boulder deposits that have been recently found out in southern Istria, at Premantura and Marlera localities and we discuss the mechanisms that could have been responsible of the detachment and movement of these large rocky blocks from the emerged part of the coast and from the sea bottom inland. A multidisciplinary approach was adopted: geological and geomorphological surveyings, UAV and digital photogrammetric analysis, applying of the hydrodynamic equations as well as underwater profiles were carried out between 2012 and 2016.

The southern Istrian coasts are composed of Cretaceous bedded limestones, sub-horizontal or gently inclined toward the sea and are exposed to southern winds, Scirocco and Libeccio, with wide fetch. The boulder deposits occur in correspondence of flat promontories or ancient quarry pavements, where the topography, together with the bedding planes and a dense fracture pattern constitute the predisposing factors of the boulder sizing and detachment.

Boulder sizes, density, position and elevation have been measured in order to apply the hydrodynamic equations, which provide wave height values that can discriminate a storm from a tsunami origin. Biogenic marine encrustations, sometimes very recent, have been observed on large part of the boulders, attesting the infralittoral and sublittoral zones as source area (joint bounded, submerged scenario). Moreover, some boulders show typical coastal karst features that are very similar to those observed in the coastal area, attesting a subaerial scenario and a consequent detachment, lifting and re-arrangement by waves.

The comparison between satellite images from 2008 to 2016, pictures collected from the WEB, pictures collected during the swim survey of the coast during summer 2012 and UAV images taken in December 2016 allowed to observe movements of some boulders and the arrival of a new one. The latter is 2.25 x 1.65 x 0.95 m, with an estimate weight of 7.65 tonnes.

Our observations and results, compared with the available wave data, seem to refer to multiple storm events, even very recent.