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Influence of sedimentary facies on rock hardness in limestone-marl alternations of the Jurassic Blue Lias Formation (Bristol Channel Basin, UK)

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In coastal environments, the reaction between minerals within the rocks and saline water may influence the physical properties of rocks (e.g. hardness). Since physical rock properties affect their erosion, they are important for coastal protection. This is especially true for the Bristol Channel Coast, since the local tidal range is the second highest in the world and determines the surface area influenced by erosion. Since these processes have not been studied in detail, we investigate the relationship between rock hardness and mineral content in limestone-marl alternations of the Jurassic Blue Lias Formation at the Somerset Coast (Southwest-England) and the Vale of Glamorgan Coast (South Wales) of the Bristol Channel.

Our study is based on sedimentological sections and hardness measurements with a portable electronic rebound hardness testing device (Equotip). Because of the principal difference between the hardness of limestones and marls, a different sensor was used for either lithology. Measurements were taken at 2 different localities. All in all 43 layers were investigated. In each outcrop 30 measurements per sedimentary layer were taken.

It seems that nodular limestone beds are characterized by a lower hardness, while laterally persistent limestone beds are characterized by a higher hardness. Additionally, it seems that marls with higher carbonate content show also a higher hardness. The results indicate a higher variability of hardness values in marls and a lower variability of hardness in the limestone beds in one section, while it is the opposite in the other section. While the lithologies of both sections are almost the same, the contact with seawater differs: the section with a higher variability of hardness values in limestones is affected by seawater at every high-tide, while the other section with higher variability of hardness values in marls is only occasionally in contact with seawater. Therefore we hypothesize that the electrolytes within the seawater react with swellable minerals such as certain varieties of clay. This, in turn, influences the mechanical properties and therefore the hardness of the rocks. To explore this hypothesis in greater detail we further analyze the mineral contents with focus on swellable minerals.