Geophysical Research Abstracts
Vol. 19, EGU2017-1386, 2017
EGU General Assembly 2017

Holocene evolution of coastal chalk cliffs in Normandy (NW France) as evidenced by onshore-offshore high resolution geomorphology

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Key words: erosion, rocky coast, cliffs, shore platform, watersheds, cosmogenic dating

The chalk cliffs coastline extends to 120 km long in Normandy. It suffers from high erosion rates with a mean of about 0.15 m/y. The shore platforms extending from the cliff base to the sea, keep structural marks of the cliff erosion during long periods, i.e. the Holocene. Therefore it is essential to take an active interest in their morphology and their evolution to better understand cliff erosion timing.
A land-sea Digital Elevation Model (DEM) has been produced for Mesnil-Val and Criel-sur-Mer sites (Seine Maritime), with the merge of topographic data (RGE alti, IGN) and shallow bathymetric data from three oceanographic Cruises, CROCOLIT-1 and 3 (Duperret, 2013) and SPLASHALIOT-2 (Maillet, 2014).
Valleys that have more or less incised Turonian-Coniacian chalk cliffs occupy the landward part of study sites. The N130E V-shaped incised Mesnil-Val dry valley is elevated at 29 m high above the shore platform level, whereas the N175E Criel-sur-Mer flat valley, extending on 700 m wide and occupied by the Yères river, is directly connected to the shore platform.
Offshore, the shore platform morphology varies from Criel-sur-Mer (North) to Mesnil-Val (South). Northern part of the study site is characterized by 1 km wide shore platform made of an overlay of flat steps controlled by normal faults. Southern part highlights a shore platform with a seaward edge located at about 500 m from the cliff face and strictly parallel oriented to the present-day coastline over a minimum distance of 5 km, without fracture control.
The shore platform seaward edge is more or less steep and is always localized below the limit of the lowest tide level. Its origin could be related to the in-depth waves influence or to a past sea level stagnation. We aim to identify the origin of this seaward edge, using cosmogenic 10Be dating in order to develop a chalky shore platform evolution model. It is necessary to take into account detailed rock lithology and rock resistance, large and small-scale structural deformation and fractures occurrences versus the sea level variations during the Holocene.
A numeric watersheds analysis has been performed inland to highlight the morphometric properties and the maturity status of each quaternary valley. They appear to be immature, even if their downstream areas demonstrate slopes varying between 0.5 and 2°. Paleo-rivers stopped to incise the chalk before reaching their equilibrium level base. We thus consider that the equilibrium point where the paleo-rivers and the past sea level were connected is located on the shore platform i.e. today located offshore. Therefore we project offshore the V-shaped valley base level, using Hack's law to estimate the paleo-coastline location. It will be correlated to the sea level fluctuations from the last interglacial period and to the Holocene shoreline recession rates known from the 10Be cosmogenic dating.

References

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