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Quantifying long-term coastal erosion: from topographic reconstruction of volcanic islands to cosmogenic isotopes

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In global geochemical cycles, the solid flux from the continent to the ocean is usually reduced to the input of sediments from rivers [1]. However, regional studies have shown that the input of sediments from rocky coast erosion may be a significant part of this flux [2]. So, it is important to consider this input into global cycles and to quantify it over different timescales.

On short-term timescales, from the year to the century, coastal erosion is currently quantified with direct measurement of the coastline retreat, between successive time intervals [3]. Extrapolating on timescales longer than a thousand years is difficult. This leads to a lack of data and therefore a gap in knowledge in longer term coastal erosion [4].

A solution to quantify long-term erosion of rocky coast is to reconstruct the initial geometry of the coastline and to know the age of its formation. Volcanic islands are suitable objects for this method. Indeed, their initial shape is simple and can be easily reconstructed, and their maximum extension can be dated [5,6,7]. Thus, the topographic reconstruction of a volcanic island allows, by comparison with its current topography, the quantification of volumes lost by erosion. In turn, it becomes possible to obtain values of the rocky coast total retreat on timescales from thousands to hundreds of thousands of years [8].

Another and complementary approach to quantify long-term erosion is the use of cosmogenic isotopes. This approach is widely used to date surface exposure and quantify long-term denudation rates in drainage basins [9]. The use of this approach to directly quantify sea-cliffs retreat is completely new. By sampling colluvial deposits resulting from coastal erosion of sea-cliffs, measuring cosmogenic ^{10}Be and ^{3}He concentrations, depending on the cliff lithology, may provide values on the retreat rate of the cliffs on the millennia timescale.

It is interesting to test both approaches on volcanic islands. Indeed, their wide geographic distribution provides a diversity of climatic and geodynamic settings allowing to analyze the effects of various factors on long-term coastal erosion. We compare and discuss the results obtained by both methods on the island of Fogo (Cape Verde).

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