HCS152 - Multiproxies of recent oceanographic and climate changes from laminated sediments of the Central Peruvian Margin

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Introduction- The Peru–Chile margin is characterized with varying patterns of high surface-water productivity and high organic carbon fluxes (Thomas et al., 2001) as well as an intense Oxygen Minimum Zone (OMZ). The combination of high productivity and near-anoxic conditions over the bottom result in the preservation of upwelling signals in the sediments by organic and inorganic geochemical processes, especially off the central Peruvian coast. We report here the results of a systematic study using organic and mineral content markers which reveal, at different time-scales, past changes in intensity and extension of the OMZ, as well as paleoproductivity, linked to different oceanographic and climate conditions.
Methodology- Two box cores were collected in these continental margin areas: in the shelf off Callao (B0405-13, 12°00'S, 72°42'S, 184 m) and in the upper slope off Pisco (B0405-06, 14°07'S, 76°30'S, 299 m). The qualitative and quantitative mineralogical composition was obtained by X-Ray Diffraction (XRD) and by Fourier Transformed Infrared Spectrometry (FTIR) respectively. For FTIR analyses, samples were placed in a KBr disc, which ensures that Lambert-Beer's law is valid. A quantitative determination of the mineral content from various blends was performed by making a multi-component analysis of the experimental spectrum using the spectra of each component in the mixture (Bertaux et al., 1998). Organic matter characterization and quantification were done using Rock-Eval 6 programmed pyrolysis, from which the following parameters were obtained: total organic carbon (TOC), hydrogen index (HI), expressed as mg HC/g TOC, and oxygen index (OI) expressed as mg CO2/g TOC.
Results and discussion- In order to estimate the representatively of the environmental proxies and their relationships, we applied two statistical tests. A principal component analysis of the proxies shows that, in both sites, more that 74% of variance is explained by two factors. The first principal component factor indicates a negative correlation between the terrigenous fraction (quartz, feldspar and clays) on one hand and biogenic calcite and TOC on the other hand. The second factor is explained by the organic fraction, which marks a negative correlation between the quantity (TOC) and the oxic degradation (OI; Oxygen Index) of marine sedimentary organic matter. The parallel dowcore variation of the two factors in the Pisco and Callao sites indicates that the studied proxies have a regional significance and that they mark a clear shift at ~1830 AD. To confirm this interpretation we applied an ANOVA test, which shows that, before and after 1830 (AD), the mineral and geochemical proxies have significant differences. Based on these results, we interpret that before 1830 (AD), there was a higher terrestrial input related with more humid conditions in the continent and/or an intensified phase of the coastal rculation. These environmental conditions may be associated with water column characteristics responsible for the lack of calcite record due to dissolution processes. From 1830 to 1870 (AD), the increase of factor 2 values, related to higher values of OI, can correspond to an episode marked by a high oxygenation of the water column favouring the oxidation of organic matter. After that, we note a negative tendency of factor 2, dominated by the increase of TOC suggesting that productivity is the principal mechanism responsible for the enhancement of the anoxic conditions of the water column. The intensification of the negative tendency of factor 2, from 1950 to present, is explained by a TOC increase simultaneously with an abrupt IO decrease. These results indicate an enhancement of anoxic conditions generated by the intensification of productivity due to wind forcing. This interpretation is supported by the increase of factor 1, which is linked to terrigenous aeolian transport at the Pisco coastal zone. Records of instrumental data also show an enhanced intensity of alongshore winds during the same period. This change is not evidenced at Callao probably because its sedimentary record was affected by bioturbation near the core top.
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