Variations in paleovegetation recorded by terrestrial plant biomarkers in the sediments from IODP Site U1385 off the SW Iberian Peninsula

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Terrestrial plant-derived biomarkers such as long chain *n*-alkane, fatty acid and alcohol are prevalent in marine sediments, and are used as diagnostic tools for reconstructing terrestrial input, paleovegetation and atmospheric conditions. Plant terpenoids, another class of higher plant biomarkers, also occur in various types of marine sediments. Chemotaxonomic feature of plant terpenoids has been emphasized by dataset of recent plant natural product as well as geochemical analysis of geological samples (e.g. peat, plant fossils and coals). Hence, compositions of plant terpenoids in marine sediments may reflect paleo vegetation and climate condition. However, occurrence and composition of these plant terpenoids in marine sediments are hardly known. In the present study, we analyzed the terrestrial plant-derived biomarkers in the sediment core recovered by IODP exp. 339 Site U1385 to reconstruct past variation of flux and composition of the plant terpenoids.

We used sediments samples from in the northeastern Atlantic off the SW Iberian Peninsula (IODP site U1385), so-called ‘Shackleton Site’. The age ranges between Marine Isotope Stage (MIS) 12 and MIS 10 are analyzed, and especially, the paleoclimatic reconstruction of the MIS 11 is focused. Several studies have been examined the climatic variations of MIS 11 by a high-resolution direct land-ocean comparison from the Site U1385 (e.g. Oliveira et al., 2016, *Quat. Res.*). Lipids were extracted with dichloromethane / methanol, and separated to aliphatic, aromatic and polar fractions. Lipids were identified and quantified by GC/MS. In addition to the plant biomarker analyses, we estimated the paleotemperatures of sea surface layer using alkenone unsaturation index (UK'_{37}).

Diterpenoids such as dehydroabietic acid (gymnosperm origin) as well as triterpenoid such as β-amyrin, friedeline and lupeol (angiosperm origin) have been mainly identified as the plant terpenoids in almost samples. The dehydroabietic acids / β-amyrin ratios, which are representative of gymnosperm / angiosperm ratios, tend to decrease during the interglacial period of MIS 11. The dehydroabietic acid is typical biomarker as conifer woods. Thus, the decreasing of the relative abundances of the dehydroabietic acid in marine sediments during MIS 11 is assumed to decline the coniferous vegetation in hinterland areas around the Site U1385. The variations in the other gymnosperm / angiosperm ratios such as total diterpenoids / triterpenoids ratios are similar trends during MIS 12 –MIS 11. On the other hand, the lupeol / β-amyrin and lupeol / total triterpenoids ratios are lower during glacial periods including MIS 12 and MIS 10, but tend to increase during interglacial period MIS 11. The lupeol is known to be originated from various angiosperms, especially legume and aster families including lupines. The variations in lupeol ratios are concordant with those in $\delta^{18}O$ values, alkenone-based temperatures, and pollen percentages of the Mediterranean forest species in the Site U1385 (Oliveira et al., 2016). Interestingly, increasing spikes are observed in the lupeol ratios during the cooling stages in MIS 11 (ca. 390 ka), and well correlated to the minimal values of the Mediterranean forest. Thus, the lupeol ratios can be an indicator of cooler vegetation. From these results, the indices using the plant terpenoids in marine sediments have potentials for reconstructing paleoclimatic variations via paleovegetation changes at the glacial/interglacial cycling during the Quaternary.

Keywords: paleovegetation, biomarker, plant terpenoid, MIS 11, northeastern Atlantic Ocean

