Shallow slab melting at the start of Western Pacific subduction: Geochemical and experimental evidence

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It is well-known that subduction initiation began throughout the Western Pacific in the Eocene. In the type area, the Izu-Bonin-Mariana forearc, the 5 m.y. following subduction initiation are characterised by a series of rocks from tholeiites to boninites. Published, and new, trace element and isotope (Pb, Sr, Nd, Hf) data indicate that magma genesis involved three components: a subduction fluid component carrying Pb and Sr; and a subduction melt component (carrying HFSE as well as LILE); and variably-depleted mantle asthenosphere. The fluid component is derived from subducting sediment and crust with a Pacific provenance, the melt component from subducting crust with an Indian (West Philippine Basin) provenance. Using Hf isotope ratios coupled with REE-Hf systematics, it is possible to identify the slab melt component as the likely product of basalt melting in the amphibolite facies. To test this hypothesis, experiments were carried out to compare shallow and deep slab melts. With published experimental data, they confirm that shallow melting gives the required melt composition, differing from adakites in its lower Sr (because of residual plagioclase), less MREE and more HREE (because of residual amphibole rather than garnet). Thermal modelling confirms that the subduction initiation setting is unique because of the combination of (a) a thin thermal boundary layer between the subducting plate and mantle wedge and (b) near-trench extension resulting from slab rollback. The different provenance of the subducted sediments and crust can be explained by inner trench wall subduction-erosion at the start of Pacific plate subduction. On Fiji, the focus of Jim Gill's classic work, it is possible that the positive Hf anomalies in some of the oldest (Eocene) rocks could also be explained by this slab-melting event.

Distribution of microbial terpenoid lipid cyclases in the global ocean metagenome

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The desire to map lipids to their sources is generating new approaches to the field of microbial 'lipidomics'. Such links are essential for deciphering the biological and environmental history of Earth. The bacterial terpenoid lipids known as hopanoids are fundamental tools for interpreting ancient microbial communities, as their degradation products, the hopanes, are found in sedimentary rocks throughout the geologic record. These compounds are presumed to be analogous to the sterols of eukaryotes, yet although the eukaryotic requirement for sterols is universal, hopanoid biosynthetic capacity is not ubiquitous among bacteria. We recently reported that 148 putative coding sequences for bacterial squalene-hopene cyclases (SHCs) were found among the 9.8 million shotgun reads from the Sorcerer II Global Ocean Sampling (GOS) expedition [*1*]. SHCs encoded by *Alphaproteobacteria* related to *Rhodospirillaceae,* and/or SHCs encoded by the newly-identified *Zetaproteobacteria* [*2*] dominate these hits, especially in the open ocean and in tropical regions. *Planctomycetes* and *Betaproteobacteria* contribute more SHC-encoding sequences, and therefore presumably more hopanoid production, to coastal and temperate environments. Although sequences nominally related to *Alpha-* and *Betaproteobacteria* outnumber other taxa in marine and coastal environments, there is large phylogenetic distance between GOS sequences and known species. Assuming that the environments sampled here are broadly representative of a wide range of surface ocean climates, depositional settings and temporal periods, the data suggest a fundamentally important contribution of *Proteobacteria* in the development of the geologic record of hopanes.

[*1*] Pearson, A. and Rusch, D. B. (2009) *ISME Journal* **3**, 352-363. [*2*] Emerson, D., Rentz, J.A., Lilburn, T.G., Davis, R.E., Aldrich, H., Chan, C., and Moyer, C.L. (2007) *PLoS ONE* **2**, e667.