Widespread diffusion of oxygen from oceanic crust into overlying sediments in the NE Pacific Ocean – early diagenetic consequences and significance for biogeochemical cycles (RV SONNE SO240)

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The classical view of early diagenetic processes in the seabed is based on exchange of oxygen (O_2) and other compounds between bottom waters and surface sediments. As a result, sediments generally show a downward succession of redox zones with decreasing energy yield of the particular redox reaction. Recently, it has been observed that the circulation of O_2-rich seawater in oceanic basaltic basement driven by temperature and pressure gradients generates an upward diffusive flux of oxygen into the overlying sediment.

Work on long sediment cores taken from the NE Pacific Ocean demonstrates that upward diffusion of O_2 is a widespread phenomenon in these deep-sea sediments. Close to seamounts, where sediment cover is thin, and larger faults, sediments are oxic throughout, with O_2 decreasing downward from the sediment surface and upward from the underlying crust. These sediments provide an exemplary insight into the processes occurring close to the sediment/basement interface. The low sedimentation rates (<0.5 cm/kyrs) and abundant supply of O_2 from above and below lead to an almost complete organic carbon (OC) mineralisation resulting in OC-lean sediments (<0.2 wt%). Ventilation of the basement may be considered omnipresent due to the pressure gradients present between spreading-zones/hot spots and old oceanic crust. As such upward O_2 transfer into overlying sediments and exchange of elements across the crust/sediment interface should be omnipresent processes as well – calling for the need to assess element redistribution in the basal sediments and crust, as well as to recalibrate the biogeochemical cycles and fluxes of carbon and other elements.