

## From whale to chemosynthesis: Energy and carbon fluxes at a deep-sea whale fall

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Sunken whale carcasses, so-called whale falls, are sulfogenic habitats supporting chemosynthetic communities similar to cold-seep and hydrothermal-vent systems in otherwise energy-poor deep-sea habitats. Whale-fall carbon is transferred to the surrounding sediments, where it becomes degraded by the benthic microbial community, or it is made available through lipid-rich whale bones, where microbes gradually consume the carbon from bone periphery to the inner core. A consequence of intensive microbial degradation processes, i.e., sulfate reduction and methanogenesis, is the release of reduced sulfur (hydrogen sulfide) and carbon (methane) into the environment where they can form a basis for chemosynthetic life. Here we present an intensive study of an originally ~30 ton whale fall in the Catalina Basin (1675m) 6-7 years after its deployment on the sea floor. Highest microbial activity was found within 0.5-m of the whale fall revealing areal *ex situ* sulfate reduction and *in-vitro* methanogenesis of up to 717 and 99 mmol m<sup>-2</sup> d<sup>-1</sup>, respectively. Rate integrations suggests that within this 0.5-m spacing, covering a sediment area of 18 m<sup>2</sup> around the whale fall, ~200 mmol free sulfide d<sup>-1</sup> were available. Sulfide production in bones was much lower, accounting for a net sulfide flux of ~10 mmol d<sup>-1</sup>. Conversions into carbon equivalents suggest that at least 122 kg (4%) and 23 kg (0.8%) of the whale carbon were consumed by sulfate reduction and methanogenesis in the sediments, respectively, and 0.7 kg (0.3 %) by sulfate reduction in the bones within the first 7 years. Comparisons will be made with energy and carbon fluxes at other chemosynthetic habitats.

## Modelling of an acid pit lake from an abandoned high sulfidation deposit: Kirki, NE Greece

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Open pit mining of base-metals and Ag from the high sulfidation epithermal type deposit of Kirki (Thrace, NE Greece) resulted in the formation of an acid pit lake by infilling of the open cast by rain and drainage waters after mine closure. The acidic and oxidative pit lake waters show high concentrations of trace metals largely due to the high toxic metals content of the ore, the limited buffering capacity of the host rocks and the direct exposure of the ore zone to weathering. The floor of the pit lake is covered by a fine-grained mineral precipitate that comprises mainly detrital quartz, dickite/kaolinite, pyrophyllite and feldspar, originating from erosion of the rocks exposed on the walls of the open pit. Secondary anglesite, several species of the jarosite-group, rozenite, melanterite, gypsum, bukovskyite, beaverite, scorodite and minor goethite are also detected. The mineral precipitate presents significant heavy metal content indicating effective removal of metals from the acidic waters. The speciation/mass transfer computer code PHREEQC-2 and the MINTEQ database were employed for geochemical modelling of the equilibrium between the acidic pit lake waters and the secondary phases of the mineral precipitate. The 'Chemical Kinetics' approach was employed in this study. Both 'Forward' and 'Inverse Modelling' were investigated, with the latter indicating that meteoric waters play a key role in the formation of secondary phases in the Kirki pit lake system.