Coupling metabolite flux to proteomics: Insights into the molecular mechanisms underlying primary productivity by tubeworm symbionts

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Deep-sea hydrothermal vents host highly productive ecosystems. Many communities are dominated by vestimentiferan tubeworms, which house endosymbiotic chemoautotrophic bacteria that provide the hosts with their primary nutritional needs. Carbon fixation rates by these symbioses are also among the highest recorded. Despite the breadth of physiological and biochemical research on these associations, the underlying molecular mechanisms that regulate host and symbiont metabolite flux, and carbon fixation are largely unknown. Here we present metabolite flux, transcriptomics and proteomics data from shipboard high-pressure metabolite flux experiments, in which we maintained *Ridgeia piscesae* and *Riftia pachyptila* tubeworms at *in situ* conditions. Our host transcriptomic libraries have extremely high representation of genes involved in cellular processing and cell-cell signal transduction, as well as high representation of genes involved in metabolite exchange and acid-base regulation. Our symbiont proteomics data reveals site-specific differences in protein expression that likely relate to environmental conditions. These concomitant metabolite flux rates and gene/protein expression studies of a chemoautotrophic symbiosis during net autotrophy allow us to develop a robust model of vestimentiferan tubeworm host and symbiont metabolism and growth, which together demonstrate that cell cycle regulation and symbiont physiological plasticity may play a significant role in maintaining physiological poise during high productivity. Such experimental approaches provide the opportunity to study metabolic activity of *uncultivable* microbes (and animals) at environmentally relevant conditions, and further our understanding of how their physiological responses to changes in the environment.

Geochemical study of the Garrotxa volcanic field (NE Spain Volcanic Province)

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The Garrotxa Volcanic Field (GVF) is part of the NE Spain Volcanic Province, a Neogene-Quaternary intraplate alkaline volcanic zone originated by the extensional tectonic setting affecting western Mediterranean since the Oligocene. The GVF displays up to 40 single small monogenetic cones formed by strombolian and/or phreatomagmatic activity, and about 30 lava flows related to the cones and to fissural activity. Rocks are basic in composition (basalts, basanites and trachybasalts) and fresh in outcrop.

Although this volcanic field is known since two centuries ago, studies dealing with the geochemistry of the rocks are scarce. Most of these studies were carried out in the 1980's and were based on few samples, corresponding to just a few units Since then chemical homogeneity was assumed for the GVF.

The present study was focused on partially solving the insufficient geochemical knowledge of this volcanic field. Many samples were collected across the GVF, but specially in the less studied zones. Whole rock chemical analyses were done, using XRF and ICP (-MS and -OES), as well as a study on the petrography and mineral chemistry of the samples.

New information was used to review all the data available in literature in order to build a comprehensive quality geochemical database which will be the reference for future studies. The study of this database showed that the assumed homogeneity of the zone was not so, allowing a preliminary chemical characterization of different units, and evidencing chemical trends that for the first time demonstrate the occurrence of magma differentiation by fractionate crystallisation.

Further studies are being carried out in order to improve the GVF geochemical database, including new sampling and integrating isotope data.

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