Owing to the presence of very rick ecosystems based on chemosynthesis, forming 'life oases' on the generally monotonous, deserted ocean floors, submarine hydrocarbon seeps constitute one of the most unique environments found on Earth. At the same time, these are sites of intensive carbonate precipitation, very unusual given the homogenous, clastic nature of the surrounding sediments. Despite significant progress made in past four decades in the understanding of processes responsible for the formation of seep carbonates, our capabilities to decipher the origin, subseafloor migration pathways and compositional changes of fluids at methane seeps remain very limited. This encourages seeking novel analytical techniques that would enable insight into the subseafloor fate of pore waters at seeps.

The goal of the proposed project is to assess the applicability of a innovative analytical technique, concentration analyses of two isotopes of neodymium, ^{143}Nd i ^{144}Nd, in studies of submarine methane emissions. Because neodymium in seawater originates primarily from dissolution of minerals found in the Earth's crust, spatial changes of neodymium isotopic ratios of seawater are a commonly used proxy of tracing circulation patterns of oceanic currents. For the same reason, neodymium isotopes can also provide a potentially useful tool of reconstructing migration pathways of fluids in the subseafloor; the method was, however, very rarely used in studies of methane seeps to date. In particular, neodymium isotope analyses may constitute sensitive tracers of the origin, migration patterns and elemental changes of solutions at seeps that are underlain by mafic igneous rocks, which characteristic feature is very significant enrichment in the lighter of neodymium isotopes, ^{143}Nd. As shown by initial studies conducted by the project's team, alteration of such rocks associated with seepage of methane-charged fluids can result in enrichment of the latter in ^{143}Nd, which, in turn, will be reflected in the peculiar isotopic composition of carbonates precipitating at seeps. By multi-proxy geochemical analyses of selected, fossil methane seeps emplaced on igneous rocks, the present project is aimed to establish the neodymium isotope analyses as a widely applicable tool in deciphering subseafloor evolution of fluids at fossil and modern methane seeps.