Deep sea sediments as a resource of Methane Hydrates and Rare Earth Elements

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Abstract

Methane hydrate (MH) and rare earth elements (REE) can be found in large quantities on the seafloor and near the seafloor layer at the sea depths from 400 to 1000 m, thus on continental shelves and in deep sea sediments. It has been showed that deep-sea mud contains a highly promising huge resource of REE and Y, containing 1000-2230 μg/g [1]. The current worldwide estimates of MH deposits range from $2x10^{14}$ m^3 to $3.053x10^{18}$ cubic meters [2]. MH deposits may be utilized in a near future as a new and environmentally sound energy resource, which can contribute to the reduction of net CO_2 emissions from fossil fuels given that the release of the gas bound in hydrates can be induced by the injection of CO_2.

REE are crucial for high-tech products such are green-energy technologies, novel electronic equipment, space development and security industry. REE can be divided in LREE (Light REE: La, Ce, Pr, Nd, Pm and Sm) and HREE (heavy REE: Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu). 97 % of REE are produced in China and almost all of deposits are LHEE. Ion-absorption type of deposits in southern China exclusively produces HREE. Enrichment of Th and U causes a serious problem of radioactive waste during the mining and smelting problem. Relatively recently, in 2011, Japan announced that they have found REE resources of deep-sea mud in their exclusive economic zone in the Pacific, and their intention and ability to exploit it. Very soon India and China have also taken an interest in sea bed exploitation of deep sea REE resources. It is presumed that ocean REE reserves are 1000 times larger than the world current land reserves. In addition, the ocean REE mud does not contain Th and U, which reduces the price and environmental risk of REE production.

Remotely operated vehicle (ROV) for the geo-prospecting of the deep sea surface resources such are MH and REE based on neutron technologies can be developed. In addition, a logging probe can be attached to the ROV for drilling analyses of a sediments layers up to several meters depth (as opposed to taking the core out) or in conventional wells (with an advantage of reduced background and precise profiling). Figure 1 shows the ROV carrying the neutron probe developed under the FP7 project UNCOSS. The ROV was developed by our group for determination of potentially threat materials such are unexploded devices, warfare agents or barrels containing unknown material dumped at the seafloor. With time of flight resolution of 2 ns, approximately 10 cm voxels could be measured for relative elemental abundances, most interesting being the C/O ratio.

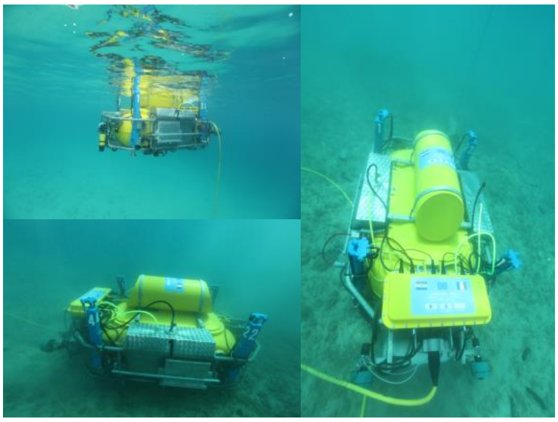

Fig. 1: UNCOSS ROV during the field test, Punat island Krk, Croatia. 06. May 2012. Detection and identification of the material inside the airplane bomb.

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