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Status of Uranium Activities on Unconventional Resources in the Philippines

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While the initial search for uranium dates back as early as 1954, it was only in 1977 that the systematic exploration approach for uranium was started under the International Atomic Energy Agency (IAEA) Technical Cooperation (TC) project PHI/3/04 "Uranium Geochemical Prospection"[1]. This was tied up with the decision of the Philippine Government at that time to establish the Philippine Nuclear Power Program and build the first Philippine Nuclear Power Plant (PNPP) in the Country. Unfortunately, due to the Chernobyl accident that happened in April 26, 1986, the first PNPP was not allowed to operate and later on mothballed by the then government dispensation, although it was almost 100% complete. This led to the discontinuance of the quest for indigenous uranium mineral deposits. However, in May 1995, Executive Order No. 243 was issued, which created the Nuclear Power Steering Committee that provided the policies, direction, monitoring, evaluation, and other functions necessary and appropriate to attain the objectives of the overall Nuclear Power Program of the country. It states, in part, that, "the Philippine Nuclear Research Institute (PNRI) shall also conduct research and development programs on the various facets of the nuclear fuel cycle, including the resumption of activities on uranium exploration"[2]. A modest reconnaissance approach using the combined radiometric and geochemical exploration method was launched that resulted in covering, so far almost 70% of the entire Philippine archipelago. Results however were disappointing as no major uranium deposition have been delineated, except for a few minor mineralizations. Hence, the strategy was shifted to sourcing uranium from unconventional resources. This gave rise to the inclusion of PNRI in the IAEA Contract Research Project (CRP 18759) "Geochemical and Radiometric Characterization of the Cu-Mo-U Occurrences in the Larap-Paracale Mineralized District, Camarines Norte, Philippines"in 2015. It is in this mineralized district that the mineral uraninite was discovered by Frost [2] in 1959 and an indicated reserve of about 200 tons U3O8 contained in 500,000 tons of ore with a grade of 0.04% U3O8 at the Bessemer pit being operated by the Philippine Iron Mines was reported by Dr James Cameron, IAEA expert in 1965 [3]. Efforts at that time to locate other uranium mineralized areas were not encouraging, although a few copper (Cu) –molybdenum (Mo) with associated uranium (U) areas were noted. These areas are now the subject of investigation by the present IAEA CRP 18759. Surveys conducted delineated within the Nakalaya locality an area having field gamma-ray spectrometric measurements varying from 104 –138ppm U with the use of RS230 gamma ray spectrometer. Fluorimetric analysis of rock and soil samples gave 39 –193ppm U while Atomic Absorption Spectrometric analysis gave 209 –588ppm Cu and 53 –363ppm Mo. Interestingly, ICP-MS analysis showed 173 –544ppm rare earth elements (REE). Recently, a more detailed gamma ray spectrometric survey pinpointed an area of about 100 meters south of the Nakalaya area having 76 –236ppm U. Laboratory analyses of rock and soil samples are still pending. This anomalous area is underlain by the Tumbaga/Universal formation of Eocene age. It is part of a sedimentary rock sequence consisting of limestone, marl and shale that was subjected to thermal metamorphism resulting to skarns, hornfels and marble that acted as hosts to the iron deposits and minor base metal mineralization with associated uranium. It is therefore aimed that uranium will be produced as a by-product or co-product if this area is shown to be economically viable to mine with the combined production of Cu, Mo and REE, including U.

Under the IAEA Technical Cooperation project PHI2010 entitled "Enhancing National Capacity for Extraction of Uranium, Rare Earth Elements and Other Useful Commodities from Phosphoric Acid", a study on uranium recovery from phosphoric acid is being carried-out. This project is being undertaken in collaboration with the Philippine Phosphate Fertilizer Corporation (PHILPHOS) and with financial assistance from the National

Research Council of the Philippines –Department of Science and Technology. PHILPHOS imports around 1.97 Mt of raw phosphate ores from different countries per year for the production of fertilizers. Samples of phosphate ores, phosphoric acid and fertilizer products were analyzed using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) to determine elemental content. Analysis showed that the phosphate ores contain uranium as high as 139 ppm with 20.5 ppm thorium (Th), including REE's up to 828 ppm. Analysis of phosphoric acid samples using ICP-MS gave values of uranium content varying from 66 –189 ppm. Phosphatic fertilizer products, particularly Nitrogen-Phosphorus-Potassium (NPK) fertilizers, contain radionuclides and REEs having values reaching up to 223.8 ppm U, 0.8 ppm Th and 36.8 ppm REE and these fertilizers are contaminating the environment upon their application. Uranium in these fertilizers is well beyond the global average of uranium content in soils, which is 0.3 –11 ppm [5]. A laboratory scale solvent extraction of uranium using a synergistic mixture of diethyl-hexyl phosphoric acid (D2EHPA) and trioctyl phosphine oxide (TOPO) from phosphoric acid was conducted. The static laboratory testing achieved a 92% recovery rate of uranium from phosphoric acid. This experiment thus led to the precipitation of the first yellowcake from phosphates in the Country. This study is projected to produce cleaner fertilizers mitigating the risk from environmental contamination, promote maximization of resources and the opportunity to utilize uranium if the Philippines will decide to go into the nuclear option.

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Country or International Organization

The Philippines

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