THE FEASIBILITY OF A NOVEL METHOD OF SOLUTION RECOVERY OF COBALT-RICH FERROMANGANESE CRUSTS FROM SEAMOUNTS

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By

Kimo K. Zaiger

Dissertation Committee:

Alexander Malahoff, Chairperson
Michael J. Cruickshank
Lorenz Magaard
Gary McMurtry
John C. Wiltshire

ABSTRACT

Significant deposits of cobalt-rich ferromanganese crust are found on seamounts in the Exclusive Economic Zones (EEZ) of many Pacific nations. The United States crust bearing EEZs encompass the Hawaiian and Johnston Island archipelagos and have a cumulative crust permissive area of nearly 27,000 km^2, averaging 40 percent crust coverage. EEZ mean crust thickness is 2.5 cm with an average grade of 0.87% cobalt. These deposits present significant high value mineral potential, for cobalt, nickel, and manganese metals with an estimated ore value of $449 per metric ton (1993 dollars).

A novel *in situ* solution mining method is introduced. This patented mining system (assigned to the University of Hawaii) uses a *Containment and Regulation Cover* that in effect creates a semi-batch reactor sealed to the sea floor and adapts terrestrial *in situ* leach mining methods to the deep ocean. The crust mining potential of the solution mining method is assessed and compared with other ocean mining technologies. This new mining system is expected to cause much less environmental damage then the environmental disruption projected from sediment plumes caused by mining crusts by mechanical methods. Also, the innovative and low cost technology of solution mining favorably alters the economic viability of the crust mining equation. A preliminary economic analysis yields an Internal Rate of Return (IRR) on investment of 33.5 percent for the crust solution mining base case scenario. If a selective high cobalt grade (1.25%) mining scenario is considered, an IRR of 47.5 percent and very short pay back periods on capital can be attained. This makes the solution mining system for crusts highly attractive.

In order for an *in situ* solution mining system to be viable, the leach kinetics and physicochemical hydrodynamics must be favorable at *in situ* conditions. Results from extensive laboratory bench and refrigerated pressure bomb experiments show rapid crust dissolution rates with greater than 90% extraction of Co, Cu, Mn, and Ni using a sulphurous/dithionate lixiviant. Experiments on intact crust fragments show that the problem of *surface layer product* formation can be mitigated by controlling the leach chemistry.