*Proceedings of the ISOPE - Ocean Mining Symposium (1995)*
*Tsukuba, Japan, November 21-22, 1995*

*ISBN 1-880653-21-4*

# Development for Hydrometallurgical Process of Cobalt Rich Crusts

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## ABSTRACT

National Institute for Resources and Environment (NIRE) has developed a hydrometallurgical process for recovery of Co, Ni, and Cu from cobalt rich crusts. NIRE process are the use of a mixture of aqueous ammonium carbonate and ammonium sulfite solution as leaching reagents, extraction of Ni and Cu in the pregnant liquor with LIX84 as organic solvent, and alcohol deposition of Co in the residue liquor. The flowsheet for recovery of Co, Ni, and Cu from cobalt rich crusts are presented.

KEY WORDS: Cobalt rich crusts, hydrometallurgy, solvent extraction, cobalt, nickel, copper

## INTRODUCTION

Cobalt rich crusts exist in stratiform states several to more-than-ten mm thick over the surfaces of rockbed, from the tops to the slopes of seamounts 800 to 2,400 m deep in the whole world. Attention is drawn to them as the third most important deep seabed mineral resources, next to manganese nodules and hydrothermal polymetallic sulfides.

Cobalt rich crusts contain Mn, Fe, Co, Ni, Cu etc., and their contents of Co are higher than those of manganese nodules, so the cobalt rich crusts are looked upon as promising cobalt resources.

For the purpose of recovery of Co, Ni, and Cu from the cobalt rich crusts, this paper describes the leaching of them by using mixture of aqueous ammonium carbonate and ammonium sulfite solution (Rokukawa, 1992), and the separation of Co, Ni, and Cu from the leach liquor by solvent extraction (Rokukawa, 1993), therfor the precipitation of Co from residue liquor by alcohol (Rokukawa, 1994).

## COBALT RICH CRUSTS

The cobalt rich crusts used for a series of experiments were collected from a seamount located in the equator zone of the Central Pacific Ocean, and stored in air. The stored crusts were crushed, and brown baserock pieces were removed. The black crust pieces were then handpicked, ground to 74 $\mu$m or less, air-dried, and sealed for use for the experiments. Two crusts used for the experiments were sampled from the seamount of the same sea area, but their shapes, the states of their surfaces and compositions were different from each other because of different sampling locations. The results of chemical analysis is shown in Table 1. The main components of the crusts are Mn and Fe. In comparison with the manganese nodules collected from the seabed of the Central Pacific Basin (Rokukawa, 1990), the crust samples contain more Co and Fe, less Cu.

Table 1 Chemical analysis of cobalt rich crusts

(Wt %)

| Element \ Sample | AD01 | AD11 |
|---|---|---|
| Mn | 24.7 | 29.7 |
| Fe | 14.7 | 13.2 |
| Ni | 0.720 | 0.840 |
| Co | 0.737 | 1.10 |
| Cu | 0.110 | 0.091 |

## LEACHING OF COBALT RICH CRUSTS

Fig. 1 shows the relations between the concentrations of ammonium sulfite and extraction of each component metal when the sample AD01 was leached by 100 g/dm$^3$ $(NH_4)_2CO_3$ solutions containing various amounts of $(NH_4)_2SO_3$ at 70 ℃ for 60 min. The extraction of each component increased with the increasing concentration of $(NH_4)_2SO_3$, but those of Co, Ni, and Cu lowered slightly at a $(NH_4)_2SO_3$ concentration of 80 g/dm$^3$ or more. The extraction of each component metal such as Co, Ni,