

Water-Rock Interaction

Edited by

YOUSIF K. KHARAKA

U.S. Geological Survey, Menlo Park, California, USA

OLEG V. CHUDAEV

Far East Geological Institute, Vladivostok, Russia

Associate editors:

JAMES J. THORSDEN, HALDOR ARMANNSSON, GEORGE N. BREIT,

WILLIAM C. EVANS & TERRY E. C. KEITH



A.A. BALKEMA/ROTTERDAM/BROOKFIELD/1995

Geochemical evidences of the accelerated growth of ferromanganese nodules due to hydrothermal supply

Y.G. Volokhin & N.N. Barinov

Far East Geological Institute, Vladivostok, Russia

Wayne C. Isphording

University of the South Alabama, Mobil, Ala., USA

ABSTRACT: A comparison of geochemistry of 97 ferromanganese nodules and crusts of the north equatorial Pacific had shown an anomalous composition of nodules from the northeastern ending of the Siqueiros Fracture Zone that is explained by their accelerated growth due to hydrothermal supply of Mn and some other elements. High contents of Mn (up to 44.1%), Ba, Zn, Li, and low values for of Pb, Co, Zr, Ce, Y, Nb are characteristic to Siqueiros nodules. The ratio of Mn/Fe (5-80) and (Fe+Mn)/Ti (110-660) indicates a mostly hydrothermal source of matter as well as a high accretionary rate of the Siqueiros nodules. Low mass equivalent ratio O/Mn (1.784 to 1.860) suggests suboxidized environment of the Siqueiros nodules, diagenesis.

1 INTRODUCTION

Rifts of the East Pacific Rise (EPR) are the main sources of hydrothermal Mn and some heavy metals in the Pacific during the latest geological periods. Mixed with the matter of other origin (river influx and others) hydrothermal material has taken a part in ferromanganese nodules and crusts formation. A comparative geochemistry is one of the useful tools to differentiate ferromanganese deposits of hydrothermal origin from hydrogenetic (that is deposits that have settled from sea water and have been lost all specific features that can be attributed to specific sources). It is also useful to estimate the contribution of initially hydrothermal matter to hydrogenetic nodules and crusts. The aim of this paper is to present results of the study of ferromanganese nodules and crusts from the North Equatorial Pacific dredged during 7th, 13th cruises of R/V "Academic A. Vinogradov", and 13th cruise of R/V "Academic A. Nesmeyanov" which were undertaken by the Pacific Institute of Oceanology (Vladivostok) during 1986-1989. Localities of the study include Ogasawara Plateau, Mikhelson and Magellan seamounts South Emperor (Jenkins, Kammu, O'Brian), Eastern Clarion FZ, and Siqueiros FZ at its joint with Tekuantepec FZ. The effects of hydrothermal activity on ferromanganese nodules and crusts occurred in many sites, but we focused our study at the Siqueiros nodules which were the best example of hydrothermally influenced nodules.

2 METHODS

Nodule and crust mineralogy was determined by X-ray diffraction of air-dried and heated powder samples (DRON-3, Cu-K α radiation with a graphitic monochromator), as well as TEM microdiffraction study using "TESLA" BS-540 (U accel.=120 kv). Wet chemical technique (for major oxides), atomic absorption spectrophotometry by "HITACHI" 180-50 spectrophotometer (for Mn, Fe, Ni, Cu, Zn, Pb, Mo, Sr, Ba, Ti, V, Co, Rb, Li, Al, Mg, Ca, Na), and neutron activation analysis (for Nb, Y, Ce, La, Nd, Zr) were used for geochemical study.

3 LOCATION OF SEQUEIROS NODULES

The Siqueiros manganese nodules were dredged at stations V13-8 (9°46'N, 99°57'W, water depth is 4120-4070m) and V13-70 (9°45'N, 100°01'W, water depth is 3770-3660m). These sites are located at the north-eastern ending of the Siqueiros FZ close to its junction with the Tekuantepec FZ. The place is on a flank of EPR eastwards about 500 km from its crest. Submarine topography represents an alternation of small ridges and valleys of the north-eastern extension with water depths changing over from 3300m to 4200m. Nodules were gained (3 kg at st. V13-68, and 50 kg at st. V13-70) from a slope of the same ridge together with a piece of basalt and pumice one.

