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Petrology, Geochronology and Geochemistry of the early Cretaceous Ophiolite Complexes in Cebu Island, Central Philippines: A Clue to Mineralization

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1 Introduction

Ophiolite complexes, believed to represent exhumed oceanic lithosphere, are potentially useful markers in the reconstruction of ancient plate boundaries. Investigations of modern oceanic basins suggest that they formed and were tectonically emplaced in different ways. In addition, their geodynamic evolution was controlled by physical-chemical conditions specific of their particular tectonic setting although geochemical signature overprinting might be common than previously recognized (Parkinson and Pearce, 1998; Tamayo et al., 2001).

Ophiolite complexes make up the bulk of basement lithologies in the Philippines. Origins of most ophiolites, including those from the Central Philippines, remain poorly understood. Exploratory studies have been done on the crust-mantle sequences in Panay, Bohol and to a certain extent of Cebu (eg. Falistino et al., 2003; Tamayo et al., 2001; Yumul et al., 2001). The geochronology of ophiolite complexes in Cebu island are weakly studied, only an age of K-Ar method was reported, yielded result of 108 Ma for the gabbros (Diegor et al., 1996). Our new geochronological and geochemical data from Cebu Island allow to well document the forming ages and genesis of the ophiolites, providing better constraints on tectonic reconstructions of the western portion of the Philippine Sea Plate prior to the installation of the West Philippine Basin.

2 Regional Geological Background

The Philippine island arc system is bound on both sides by trenches (Fig. 1). The Manila-Negros-Cotabato trench system defines the western boundary, while the East Luzon Trough- Philippine Fault, which accommodates whatever stress that the two binding trench systems cannot accommodate. In the east, it is Philippine Trench. The Philippine archipelago is surrounded by five marginal basins, South China Sea, Sulu Sea, Celebes Sea, Molucca Sea and West Philippine Sea, with back-arc basin, mid-ocean ridge, island arc and ocean island geochemical affinity. Running along the whole length of the archipelago is the sinistral Philippine Fault Zone. Central Philippines is made up of the islands of Panay, Negros, Cebu, Bohol, Leyte and Samar (Fig. 1). It is bounded by the east-dipping Negros Trench in the west and the west-dipping Philippine Trench in the east. The left-lateral strikes lip Philippine Fault Zone and the Sibuyan Sea Fault traverse Central Philippines in Leyte, and offshore north of Panay, respectively (Dimalanta et al., 2006). Lherzolites and harzburgites, metamorphic and volcanicrocks as well as a Cretaceous sedimentary units are consisting of the basement complex of Cebu. Cebu ophiolitic complexes are composed of gabbros and pillow lavas, with lherzolite in the residue. Layered ultramafic/ cumulate rocks are absent in the area (Diegor et al., 1996).

3 Sample Description

There are two types of rocks recognized in the Cebu Island, those are gabbros and volcanic rocks. The gabbros occurs as dike (Fig 2a) with main minerals pyroxene and plagioclase. The volcanic rocks are basaltic to andesitic rocks essentially composed of massive lava flows, breccias, and pyroclastic rocks. Pillow structures were found in basalt and andesitic lavas(Fig 2-c, -d), The textures of the basalt-andesite varies from aphanitic, fine– to coarse– grained porphyritic to amygdaloidal.

4 Geochronology and Geochemistry

New LA-ICP-MS U-Pb dating of the andesitic

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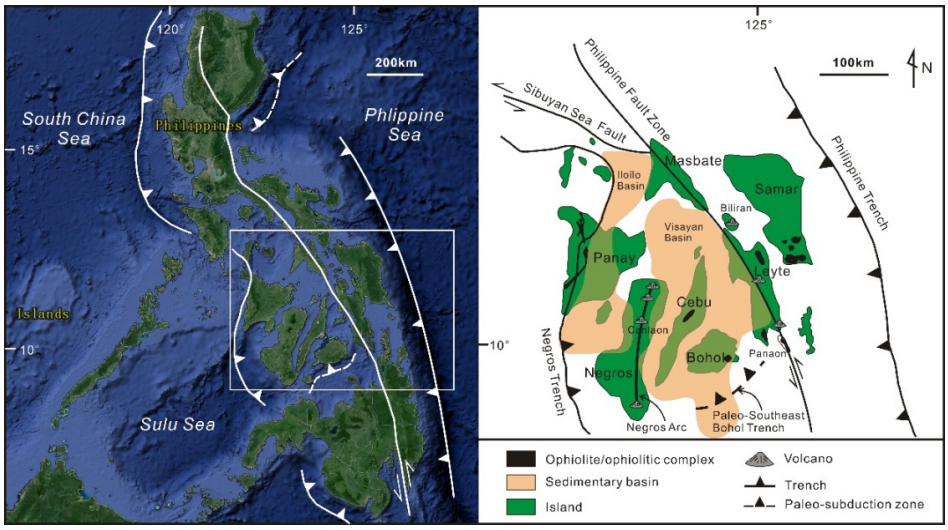

Fig. 1. Sketch map showing geological settings of Central Philippines. After Google Earth and Dimalanta et al. (2006).

pyroclastic rocks yield an age of 119.7±1.5 Ma, indicating an Early Cretaceous forming age, about 10 Ma earlier than previous result of 108 Ma by K-Ar method (Diegor et al., 1996). The gabbros are mainly classified as monzogabbros on the TAS diagram and the volcanic rocks are mainly classified as trachybasalt to basaltic trachyandesite. All the gabbros and volcanic rocks show K rich features, indicating a metasomatised mantle in the origin. They show similar REE distribution diagrams with enriched LREEs. On the trace element distribution diagram, they are rich in LILEs such as Rb, Ba, Sr, Pb and depleted in HFSEs such as Nb, Ta, Ti. The geochemical signatures of the Cebu samples show typical of island arc volcanic rocks affinities.

5 Implication for Geodynamic Settings and mineralization

Our study shows that the Cebu ophiolitic complexes are supra subduction zone type, as other ophiolites in Central Philippines. The potential mineralization in this region is chromite/or magnesite, which are usually related to the ophiolites. They were originated from the subduction of proto-Philippine Sea Plate.

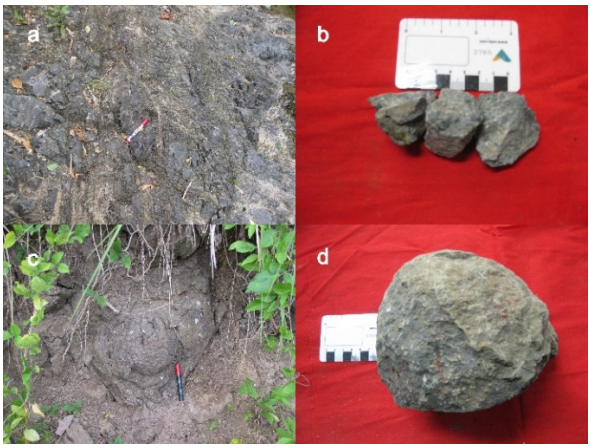

Fig. 2. Photos of the ophiolitic complex, Cebu Island.
a. Outcrop of gabbro; b. Sample of gabbro; c. Outcrop of pillow basalt; d. Sample of pillow basalt.

Acknowledgements

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