Lithological Composition of Island-Arc Complexes in the Russian Far East

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Abstract—The results of study of geochemistry of terrigenous rocks from the contrast (in structure) Cretaceous–Paleogene complexes of Sikhote Alin and Kamchatka are summarized. The data obtained were interpreted based on comparison with the geochemical composition of recent and ancient sediments accumulated in the well-known geodynamic settings. It is shown that the chemical composition of terrigenous rocks and some petrochemical ratios can serve as reliable indicators of various island-arc settings. These indicators make it possible to discriminate sufficiently reliably these settings in paleobasins of orogenic zones.

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Study of the lithology of terrigenous rocks has a great importance for elucidating sources of terrigenous material, determining the provenance composition, and, ultimately, elucidating paleogeological constraints of their formation.

According to investigations of recent and ancient sediments, the chemical composition of terrigenous rocks, sandstones in particular, is defined to a significant extent by the lithology of parent rocks and their distribution in certain tectonic settings. It should be mentioned that postsedimentary transformations of sediments give rise to mineral assemblages that are most stable in the supergene zone, while the chemical composition of rocks remains virtually unaltered.

The author of the present communication investigated the chemical composition of terrigenous rocks from genetically different complexes (island-arc varieties included) in the Russian Far East and sediments from marginal seas of the Pacific (Geologo-geogizcheskie..., 1990; Malinovsky, 1993; Malinovsky et al., 2005a; Markevich et al., 1987, 1996, 1997; and others).

The island-arc setting is commonly recognized based on several features: paleontological position, structure and composition of rock sequences therein, and petrochemical characteristics of volcanics. The aim of the present communication is to demonstrate specific features of the lithochemical compositions of terrigenous rocks from various (in age and origin) island-arc complexes of the Russian Far East and to show the possibility of such features for the identification of various settings in ancient basins. The paleoreconstruction method based on the composition of terrigenous rocks should be particularly helpful for the study of Phanerozoic volcanosedimentary rocks in terranes with insufficiently studied genesis.

The most favorable objects for such reconstructions in the Far East are represented by some well-known terranes, the island-arc nature of which has mainly been established based on the study of volcanic rocks. Data based only on the chemical composition of rocks are undoubtedly insufficient for the comprehensive identification of island-arc settings. However, such data coupled with other materials can be used as a sufficiently reliable criterion.

MATERIALS AND METHODS

The present work is based on original material pertaining to the chemical composition of terrigenous rocks from different aged island-arc rock complexes in the Russian Far East. We investigated sandy and clayey rocks from Early Cretaceous and Early Cretaceous–Cenozoic rocks of the Olyutor terrane (eastern Kamchatka), as well as the Kema and Kiselevka–Manoma terrane (Udyl fragment) of Sikhote Alin (Fig. 1). Our main attention was focused on sandy rocks. The silty–clayey rocks ranging from the coarse-grained siltstones to mudstones were less studied. Such attention to sandstones was dictated by the fact that they bear the most valuable information pertaining to the type and composition of provenances and to the geodynamic settings of feeding and sedimentation zones.

The rock material used in our work was taken from natural exposures and minings during field works in 1978–2005.
The petrographic composition of rocks was studied with a polarization microscope. Contents of the major oxides in rocks were determined by the traditional chemical method. In total, we analyzed 1077 specimens of sandy and sandy–silty rocks. Analyses were performed in physicochemical analysis laboratories of the Far East Geological Institute (Vladivostok).

Interpretation of the chemical composition of terrigenous rocks was based on the well-known and sufficiently tested methods described in (Bhatia, 1983; Maynard et al., 1982; Roser and Korsch, 1986) that allow one to recognize analogues of the recent geodynamic settings in the geological past.

**GEOLOGICAL POSITION AND STRUCTURAL FEATURES OF ROCKS IN THE REGION**

The *Olyutor terrane* is located at the southern Koryak Highland and extends in the east-northeastern direction along the coast of the Bering Sea over 500 km. The terrane, a part of the Mesozoic—Cenozoic Sakhalin—Kamchatka orogenic belt, is separated in north from the Koryak Highland by the Vatyn overthrust fault (*Geologiya…*, 1987). The geological section of the terrane comprises large allochthonous slabs (Chekhovich, 1993) composed of Early Cretaceous—Neogene rocks that were formed in different facies settings, probably, at a great distance from the present-day position. Based on (*Geologiya…*, 1987; Kovalenko,