

An attempt to relate magma's crystal differentiation with formation of basaltic and rhyolitic volcanic island arcs of the Izu Islands as the learning material

*Shunichi Sato¹

1. UT Ocean Alliance

1. Background and purpose

Since the Izu Islands are oceanic volcanic islands, they should originally be all basaltic volcanic island rows. Although it tends to be thought, surprisingly, Niijima, Shikinejima, and Kozushima Islands form rhyolitic volcanic island rows. And, on the east side, basaltic volcanic island rows such as Oshima, Toshima, Miyakejima, Mikurajima, Hachijojima Islands are lying, it is a seemingly strange array of two rows. Why is volcanic island row formed from rhyolite rock magma which can be at the final stage of crystal differentiation exist parallel to basaltic volcanic islands offshore. Consideration about its origin and also about the birth, growth and expansion of the typical basaltic volcanic island such as New Nishinoshima, I think, those are good educational materials to deepen understanding about magmatic "crystal differentiation" and arc formation. Based on the Izu Islands belonging to the Tokyo metropolitan's familiar area as the material, I introduce examples of practical topics on the geological educational theme like this taken up in classes. I will report a part of it.

2. Method ·Description

On the Izu Islands, it seems that it is one of the rare examples in the world as a bimodal event that both basaltic volcanic islands and rhyolitic volcanic islands exist side by side in Pacific Ocean. However, this fact is considered to be an advantageous and valuable teaching material for learning the nature of magma, the eruption style of volcano and the form of volcano.

Regarding the development mechanism of rhyolitic magma, textbooks include a schematic explanation diagram as a model. Based on the model, next two ideas could be arisen. < Draft 1 > By subsiding and sinking of the Pacific plate under the Philippine Sea Plate, magma is supposed to occur. This suggests that as the ascending path becomes longer, the elapsed time since the magma evolves becomes longer, so the crystallization differentiation progresses to the extent that the magmatic nature changes to quality following as the Basaltic material → Andesitic one → Daisitic or Rhyolitic one, as a result. < Draft 2 > By extensional force field (crack etc.) caused by collision, submergence and sinking of the Philippine Sea plate which is carrying the Izu Peninsula and the Izu Islands below the Honshu side plate, "partial melting" in the crust to occur. This another one suggests that in a part of the continental crust (partial deformation) due to some cause (pressure phenomena or temperature rise), partial melting occurs, and staying at that position but with the passage of time, granitic rich in SiO₂ % (or rhyolite quality) magma is formed and eventually appears on the sea bed surface (or on the sea level). Whether it is one of the above two theories, it seems that the elucidation has not been fully understood academically now. However, in any case, it can be said that the core part of the scenario where the magma generated by the partial melting of the plate and the crust eventually reaches the rhyolitic magma due to the crystal differentiation effect, and both can be almost the same conclusion. Therefore, I have taken up to the topic in the class, because these learning materials could make the description items like textbooks more familiar and also could utilize it. Even in the case of geological excursion to the site, it is convenient for traveling to learn by watching while easily compare the relationship between lava nature and volcanic island shape at the same time, because those islands are tied through a same route. So I often solicited applicant students and often carried out excursion in the summer season by myself.

3. Results and discussion

In the lesson based on this materials, I introduce, the main questions and issues issued from the students are as follows. The one for < Draft 1 > is that "why is not the formation of andesitic magmas visible?", next one for < Draft 2 > is that "Niijima, Shikinejima, Kozushima Islands are all on the ocean and why they can be said to be a continental crust? It is strange". The total time required for a series of learning processes is scheduled to be around 30 minutes, including group review and presentation activities. Though I insist repeatedly, correct answers are not provided. However, we learned that by relating the learning matters of "crystal differentiation" which is textual description items to our familiar area's learning-matters of Izu Islands in Tokyo, I felt that the merit of using them is great.

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Niijima/Shikinejima /Kouzujima