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Roles of Basaltic Lower Crust for a Periodically Refilled Magma Chamber

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A series of primary magmas supplied from the mantle seems to be transformed by crystallization in a refilled chamber into a magma with the average composition of upper continental crust, via a series of calc-alkaline magmas. One of mechanical mechanisms that have such power is a system of coupled magma chambers. It consists of a lower chamber lying at the base of crust and an upper chamber lying at the middle of crust. They are connected by a cylinder and a plug lying between them. This mechanism is important in a sense that crystallization in it has a power to give good explanation for the genesis of calc-alkaline igneous rock series and continental crust. However, its presence has not yet been well confirmed. Therefore it is necessary to accumulate the evidence through geological surveys, and chemical and physical examination of the system.

It is well understood that those, which carry evidence, are volcanic rocks. However, Outlook of what type of investigation should be done is not easy, due to complexity of chemical differentiation of magma in a refilled chamber. One way to help it is to study characteristics and differentiation trends of magma composition through simple simulation of a simplified refilled chamber system. Here, we assumed primary magma and lower crust are well deleted in water and alkali elements, and also assumed that a heat transfer coefficient between magma and the surrounding crust, a melting point of the crust and a thickness of crust are all variables and then examined variations of magma temperature, upper chamber position in the depth direction and size of magma, in a stirring state, in a refilled chamber lying in the lower crust. Four of results are as follows. 1.High melting points is necessary for the magma chamber to grow. 2.The magma chamber rises up as the result of settling of crystalline materials formed by crystallization from the magma and digestion of the ceiling crust of the chamber by the magma. Upper and lower limits of the temperature that varies with time in a saw-tooth fashion depends on magnitude of heat transfer coefficient, melting point of ceiling crust and thickness of overlying crust. The points are that lower limit rises more, though at decreasing rate with time, depending on higher melting point of crust and thinner overlying crust and finally becomes constant. This is confirmed by the evidence observed on compositional variations of volcanic rocks plotted on MgO vs. K2O diagram. 4. If the overlying crust becomes too thin, then the digestion of crust comes to stop. This is confirmed by the corresponding variation of strontium isotopic composition of volcanic rocks.

Keywords: refilled chamber, calc-alkaline volcanic rocks, continental crust, thermal chamber evolution