Preparation of Korean granite reference material (KG1): Its homogeneity, major and rare earth element composition

K.-H. KIM, S.-G. LEE, M.-K. YANG AND S.-G. CHUN[1]

KIGAM, Daejeon 305-350, Korea (khk@kigam.re.kr, sgl@kigam.re.kr, ymk@kigam.re.kr, skchun@kigam.re.kr)

Reference materials play an important role in supporting measurements in the geological sciences. Particulary, granite reference material is very important in measuring chemical compostion of crustal rocks. Since 1990, the Korea Institute of Geoscience and Mineral Resources (KIGAM) has prepared thirty six geochemical reference materials for the determination of major, minor (including rare earth elements). In this paper, we report mineralogy, homogeneity and chemical composion of a Korean granite reference material KG1. The KG1 is Createaceous biotite granite, which occurs at Sokrisan area, the middle part of Korean peninsula. The granite consists of quartz, K-feldspar, plagioclase and biotite with accessory minerals such as chlorite, sphene, zircon and magnetite. A 500kg sample of starting material was collected from active granite quarry. In this paper, thirty eight major, minor and trace elements are presented to support future collaborative analysis. Particularly, 30 splits were selected at random, and analyzed in 5 samples by XRF in the Geochemical Anaysis Center of KIGAM. We also measured intensity 5 times in a sample for homogeneiety test. The homogeneity tests showed that all elements studied can be considered to be homogeneously distributed in 95% confidence. Following data compilation (Table 1), outlier rejection, and statiscal analysis, proposed and indicative total element concentrations are reported for twenty five elements.

Table 1. Homogeneity test data

Element	XRF CPS Mean value (n=800)	Std. deviation
SiO_2	128,011	470
Al_2O_3	17,298	60
Fe_2O_3	39,897	181
CaO	4,235	14
MgO	50	1
K_2O	50,764	124
Na_2O	619	12
TiO_2	1,661	8
MnO	1,352	36
P_2O_5	89	3

SMOW-scale for isotopic ratios of NBS-28 quartz and some other reference silicate minerals

MINORU KUSAKABE[1] AND YUKIHIRO MATSUHISA[2]

[1]Institute for Study of the Earth's Interior, Okayama University, Misasa, Tottori-ken 682-0193, Japan
[2]Geological Survey of Japan, AIST, 1-1-1 Higashi, Tsukuba 305-8567, Japan

NBS-28 quartz is often used as a reference for reporting oxygen isotopic composition of silicates and oxides. Its oxygen isotopic ratio has been assigned to 9.58‰ with respect to VSMOW based on the compilation of literature values [1]. However, individually reported values range from 8.8 to 10.0‰. This variability arises from different ways of fluorination using conventional or laser heating method with BrF_5, ClF_3 or F_2 as a fluorination reagent. The choice of gas (CO_2 or O_2) for mass spectrometric measurement may also contribute to the variability. The VSMOW-SLAP scaling of the measured $\delta^{18}O$ values needs to be applied [1]. If oxygen isotopic ratio of CO_2 recovered from NBS-28 quartz is compared with that of CO_2 in equilibrium with VSMOW, the choice of variously reported fractionation factors between CO_2 and H_2O [2] affects the $\delta^{18}O$ value.

To minimize such potential uncertainties described above, we directly compared oxygen isotopic ratios of O_2, liberated from silicate minerals using a laser fluorination technique with BrF_5 as a reagent, with those of O_2 from VSMOW prepared using the same fluorination line after minor modification for water. The VSMOW-SLAP scaling was also taken into account. $\delta^{18}O$ values of NBS-28 quartz, NBS-30 biotite, UWG2 garnet [3] were 9.30‰ (n=13), 5.01‰ (n=7), and 5.72‰ (n=50), respectively. $\delta^{18}O$ values close to 9.3‰ have been obtained for NBS-28 quartz by those who used O_2 as an analytical gas. $\delta^{17}O$ values were also measured. The analytical precision was better than 0.1‰ for both $\delta^{17}O$ and $\delta^{18}O$. The results plot on the terrestrial fractionation line defined as $\delta^{17}O = 0.52 \times \delta^{18}O$ [4].

References

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