

## **TEM and MAS NMR spectroscopic studies on obsidian glass in welded tuff, Ulleung Island, Korea, with emphasis on sanidine microlites as impurities**

JI HYEON IM<sup>1,2</sup> AND CHANG OH CHOO<sup>2</sup>

<sup>1</sup> Korea Institute of Geoscience and Mineral Resources,  
Daejeon, 34132, South Korea (jhim@kigam.re.kr)

<sup>2</sup> Department of Geology, Kyungpook National University,  
Daegu, 41566, South Korea (mineralogy@hanmail.net)

The black glassy obsidian is found at the southwestern part of Ulleung Island, Korea. It occurs in BAF (block-and-ash flow) deposit due to the welding process [1]. It seems likely that the glassy matrix in obsidian is mostly homogeneous, amorphous phase when seen under polarized microscope. But, it is rarely found that the glassy obsidian contains a small proportion of alkali feldspars, diopside, biotite, Ti-Fe oxides, or Fe-oxides as microlites and phenocrysts at high magnification under EPMA-BSE observation. For this reason, we examined nanostructure of the obsidian glass with a small area of 10 micrometers after FIB (focused ion beam) preparation for TEM analysis. The pure glass part separated from obsidian was analyzed using <sup>29</sup>Si, <sup>27</sup>Al, <sup>23</sup>Na MAS NMR spectroscopy, followed by XRD analysis. On TEM images, the obsidian glass is composed of amorphous silica phase and sanidine microlites or nanocrystals, both which have gradational or individual domain boundaries. They are commonly associated with trace amount of nano-sized, equant Fe spots scattered in the glassy matrix. It is probably true that a small amount of impurities such as microlites and Fe-oxides in the glass affects the chemistry of obsidian. The <sup>29</sup>Si NMR spectrum for obsidian glass is composed of one peak identified at -96.9~97.2 ppm. <sup>27</sup>Al NMR spectra shows one peak at 52.46 ppm for <sup>41</sup>Al and <sup>23</sup>Na NMR spectra shows one peak at -25.53 ppm indicating one site. Such characteristics of the obsidian glass indicate the fact that obsidian does not have pure silica composition, well consistent with EPMA result that the obsidian glass has quite complex chemistry corresponding to alkali-bearing aluminum silicates. It is evident that sanidine needles with very high aspect ratio, occurring as microlites or nanocrystals in the obsidian glass, formed at rapid cooling stage, characterized by incipient crystal growth during the welding process.

[1] Im and Choo (2017) Economic and Environmental Geology, **50(2)**