

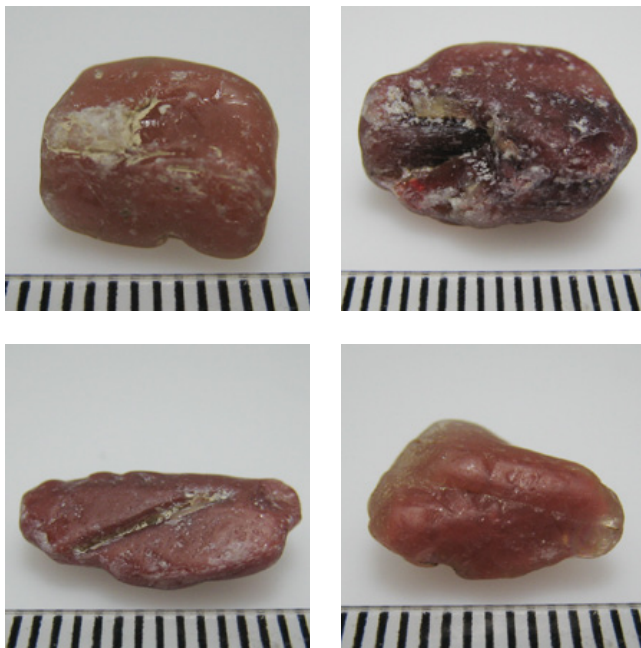


## SEM STUDY OF RED ANDESINE

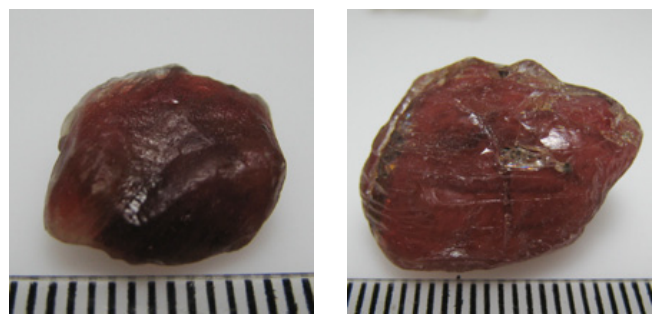
*Thanong Leelawatanasuk, Wilawan Atichat, Pornsawat Wathanakul and Namrawee Susawee*

### INTRODUCTION

Preliminary SEM (Scanning Electron Microscope) analysis was conducted on surface of four samples of the Tibetan red andesine (three from Nai Sa village, Binang and one from Yu Lin Gu) (see Figure 1) and two samples of the Chinese copper-diffusion-treated andesine (see Figure 2) with the aim at revealing surface features of both types of materials on micro-scale levels. The high resolution images at superb high magnification (200–10,000 times) may give the information that could explain the exact nature of surface features and how it was formed.



*Figure 1. Four samples of the Tibetan red andesine (three stones from the left are from Nai Sa village, Binang and one on the right is from Yu Lin Gu).*



*Figure 2. Two samples of the Chinese copper-diffusion-treated andesine.*

### INSTRUMENT AND METHODS

The SEM analysis was undertaken with JEOL JSM-5800LV instrument equipped with Energy-Dispersive Spectrometer (EDS) at the Scientific and Technological Instrument Center, Chulalongkorn University (see figure 3). All samples were ultrasonically cleaned with distilled water without any chemical additive to avoid chemical reaction that may affect the surface features and residues. All samples were coated with gold to reduce charge induced on the surfaces.



*Figure 3. The SEM-EDS (Model JEOL JSM-5800LV) at the Scientific and Technological Instrument Center of Chulalongkorn University.*

## RESULTS

### The Tibetan red andesine samples

The SEM images of the Tibetan red andesine samples of both Binang and Yu Lin Gu areas show clear percussion marks on their surfaces (see Figures 4 and 5). This feature indicates that these andesine gravels underwent naturally water-worn process during transportation from their sources to the site of deposition and/or geologically reworking sedimentation.

The whitish residues on their surfaces and in some fractures were proved to be crystalline materials containing silicon (Si) as their major element composition, which is likely to be a micro-crystalline silica ( $\text{SiO}_2$ ), or fine-grained quartz ( $\text{SiO}_2$ ) particles in the fractures (see Figures 6-7). In addition, the micro-scale copper clusters with a clear dendritic pattern growth were observed on some of those  $\text{SiO}_2$  residue patches of the Tibetan red andesine from Nai Sa village, Binang. (see Figure 8)

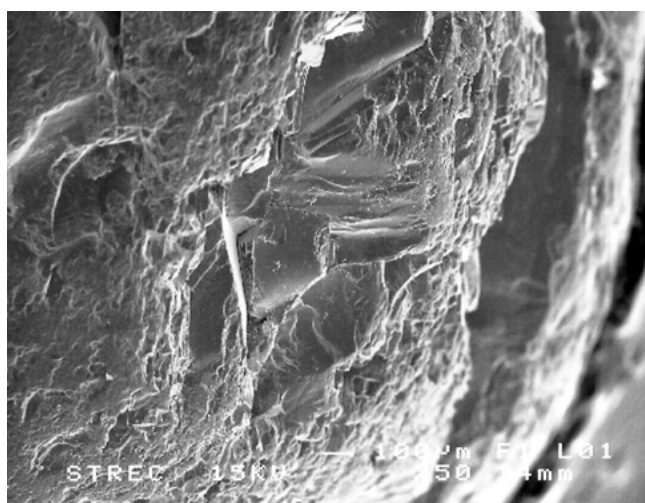


Figure 4. SEM image revealing percussion marks on surface of andesine from Nai Sa Village.

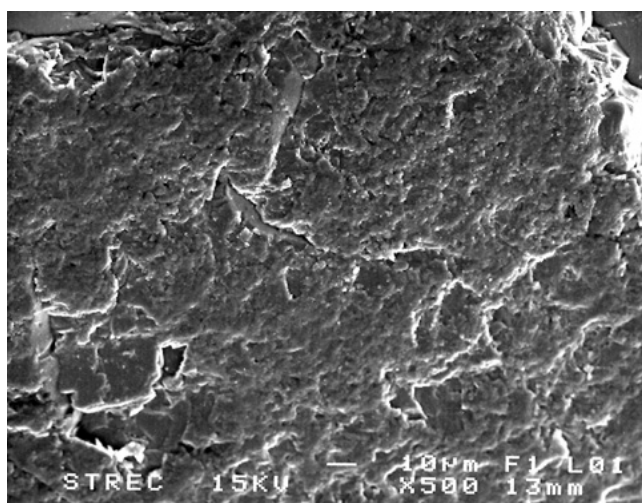


Figure 5. SEM image revealing percussion marks on surface of andesine from Yu Lin Gu.

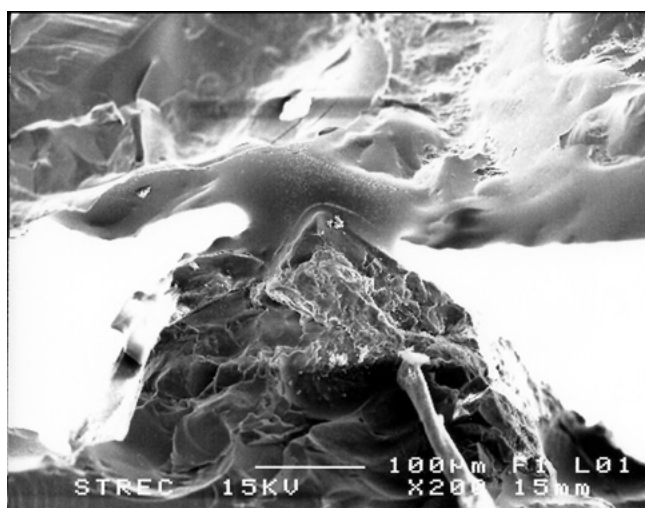


Figure 6. SEM image showing subhedral micro-crystalline silica residue in fracture of andesine from Nai Sa Village.

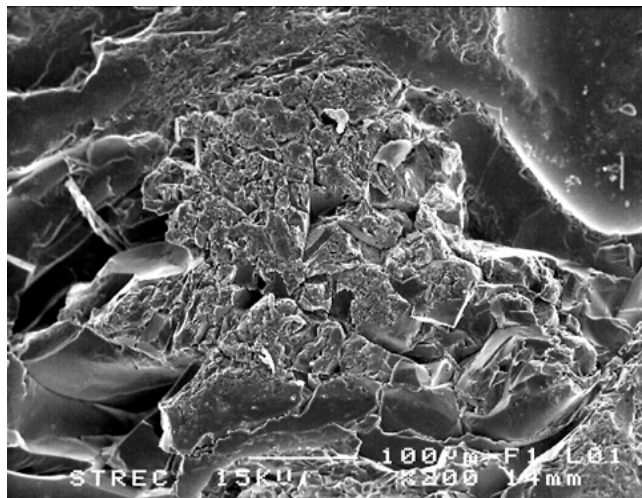


Figure 7. SEM image showing cluster of micro-crystalline silica residue on surface of andesine from Yu Lin Gu.

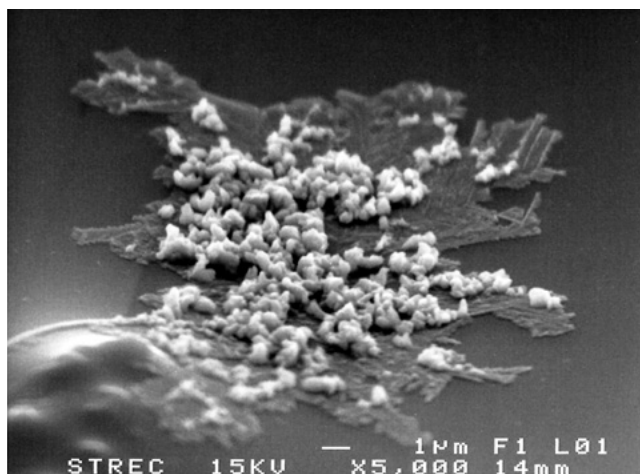
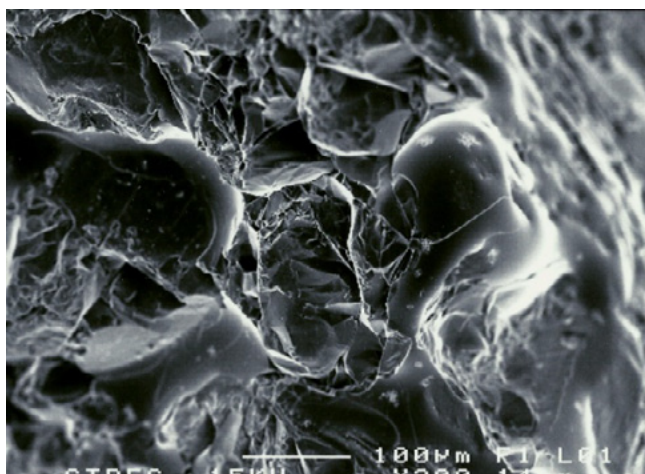


Figure 8. Two SEM images showing micro-scale copper clusters at 200X magnification (left) and at 5,000X (right) with dendritic pattern growth on surface of crystalline silica matrix of andesine from Nai Sa Village.

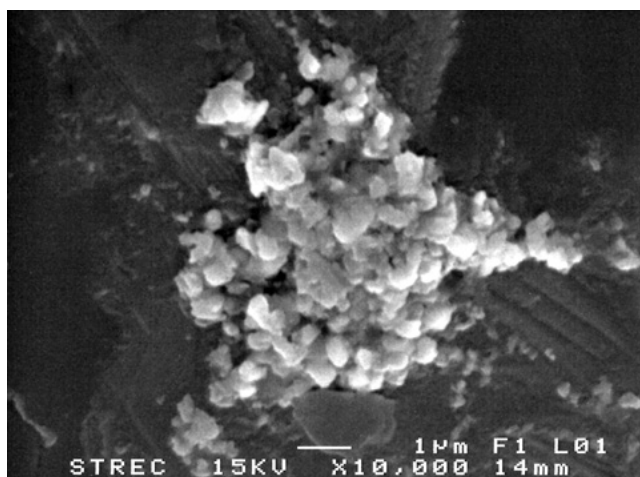
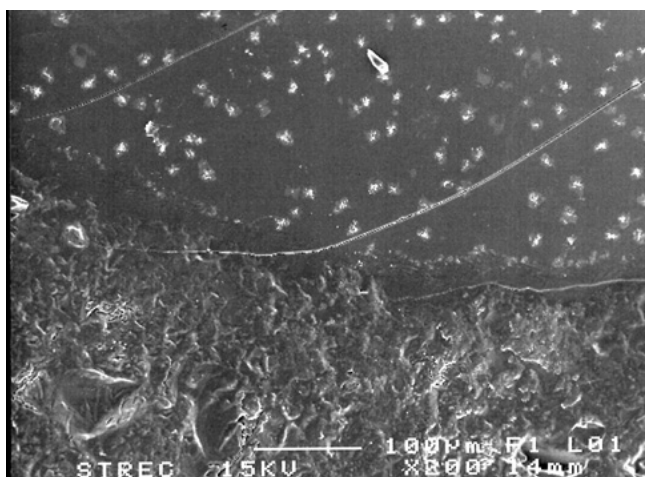


Figure 9. SEM image showing glassy residue with numerous copper micro-clusters on surface of Chinese copper diffusion-treated andesine.

Figure 10. SEM image showing copper micro-clusters on glassy residue of Chinese copper diffusion-treated andesine.

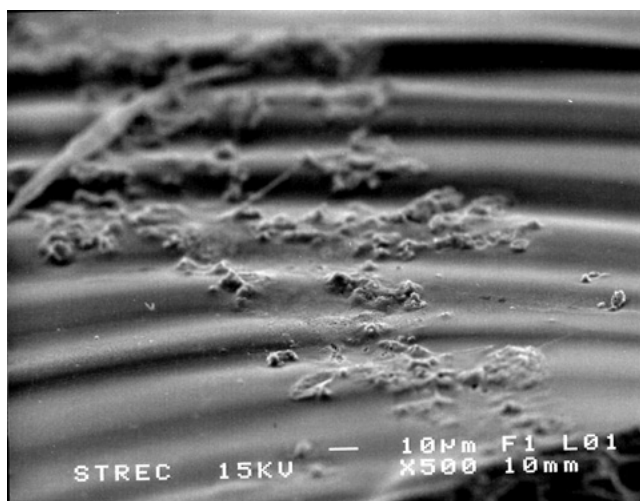
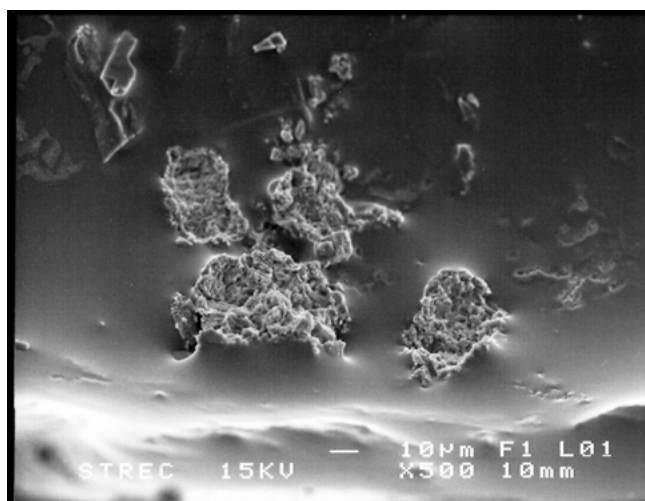


Figure 11. Two SEM images of alumina compound residue on glassy surface of Chinese copper-diffusion-treated andesine.

### **The Chinese copper-diffusion-treated andesine samples**

The SEM images of Chinese copper-diffusion-treated red andesine samples reveal mainly glassy surface and residue due to prolong treatment with flux. No any percussion marks can be observed on these treated materials. However, numerous copper micro-clusters were also found on non-crystalline SiO<sub>2</sub> matrices (see Figures 9 and 10). The other materials such as an alumina compound which is likely to be an argillaceous alteration product was also found (see Figure 11).

### **CONCLUDING REMARKS**

This preliminary investigation reveals that even though both types of samples contain copper micro-clusters on their silica-based surfaces. The surface of Tibet andesine material is of the micro-crystalline silica form, whereas that of the copper-diffusion-treated product is of amorphous or non-crystalline silica. For more conclusive results, however, the SEM study together with other techniques need to be further conducted in order to understand the naturally formed material and artificially diffusion-treated product, and finally to be able to separate the natural from the treated ones. Moreover, mechanism of diffusion would also be carried out to differentiate between natural process and artificial one.

### **ABOUT THE AUTHORS**

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Note: This report accompanies the following article: Abduriyim A., McClure S.F., Rossman G.R., Leelawatanasuk T., Hughes R.W., Laurs B.M., Lu R., Isatelle F., Scarratt K., Dubinsky E.V., Douthit T.R., Emmett J.L. (2011) Research on gem feldspar from the Shigatse region of Tibet, *Gems & Gemology*, Vol. 47, No. 2, pp. 167–180.