



A STUDY OF ANDESINE MATRIX SPECIMENS PURPORTED TO BE FROM TIBET

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Abstract

During the investigation of red andesine from Tibet, several samples of what appeared to be andesine in matrix were provided. This article documents the examination of these specimens with the goal of proving or disproving their authenticity. Microscopic examination, Raman, LA-ICP-MS and ATR were used and the results are presented. The findings strongly suggest these specimens are manufactured.

With almost any deposit of gem material, very useful information relating to the nature of the deposit can be obtained from the host rock in which the gem material is found. When Christina Iu of MP Gem Corporation approached us at the Tucson gem show in February 2008 about proving that a Tibetan source of red andesine was legitimate, the question of the host rock was one of the points that was eventually brought up. The nature of the mine (later shown to be alluvial) was unclear at the time. In an effort to help investigate this question, over the next couple of months, Christina supplied three specimens of matrix with from one to three pieces of red andesine visible at the surface and 12 additional andesine specimens with matrix still attached (figure 1).

These specimens were all said to have been supplied to her by Li Tong, the man who she understood was the mine owner at the time. An additional larger matrix specimen was thoroughly examined at the GIA lab in Bangkok in 2010. If these specimens could be shown to be true examples of red andesine in matrix it would constitute strong evidence that these stones were not treated. It was becoming clear that a

great deal of the red andesine being sold in the market was actually diffusion treated, so proving the authenticity of these specimens could be very important.



Figure 1 – Three specimens (one of which is shown here) of a calcium carbonate rock with one to three pieces of andesine visible at the surface were supplied to GIA in 2008, along with 12 pieces of andesine with the calcium carbonate rock still attached. The matrix specimen measures approximately 9.0 cm across. The largest of the andesine specimens measures approximately 20 mm in length. Photos by C.D. Mengason.

All the matrix material had a similar appearance, consisting of a light gray porous substance containing tube-shaped structures (figure 2). The matrix was found to be calcium carbonate (mostly calcite) that apparently formed by secondary precipitation (i.e., caliche), and there were no other minerals present remotely similar in size to the pieces of feldspar. Such a matrix has not previously been reported for andesine. Indeed, it is not the kind of rock in which one would normally expect to find feldspar. The pieces of andesine themselves had mostly rounded edges and frosted surfaces (figure 3), suggesting they were worn by alluvial processes sometime before being caught up in the calcium carbonate.



Figure 2 – The matrix was very porous and a light grey color with tubular formations. There were no other rocks or pebbles present in the matrix that came close to the size of the andesine pieces. Photo by K. Scarratt.



Figure 3 – The andesine embedded in the matrix had mostly rounded edges and frosted surfaces, indicating they had been worn by alluvial processes sometime before ending up in the matrix. Photo by S. F. McClure. Field of view approx. 25 mm.

Closer inspection of the specimens revealed additional features that were hard to explain. In many pieces, junctions between the andesine and matrix contained a transparent to translucent material that resembled liquid but proved to be solid when probed. It “wetted” the surrounding matrix, filling in pores and making them shiny (figure 4), often forming a meniscus where the feldspar came in contact with the matrix (figure 5). Occasionally a white crackled appearance was visible (figure 6). LA-ICP-MS chemical analysis of this contact material showed mostly aluminum with some silicon and calcium, as well as some trace elements. No spectral match—or polymers—were found using Raman spectroscopy. It is important to note that this material was only present in association with the feldspar – it did not appear anywhere else in the matrix.



Figure 4 – The contact material found where the andesine and matrix met often had the appearance of “wetting” the matrix, filling in the porosity and making it look shiny. Photomicrograph by S. F. McClure. Field of view 4.0 mm.



Figure 5 – In some cases the contact material formed a meniscus where the andesine and the matrix met. Photomicrograph by S. F. McClure. Field of view 2.1 mm.



Figure 6 – In some areas this contact material had a whitish crackled appearance and even appeared to be flaking off. Photomicrograph by S. F. McClure. Field of view 1.75 mm.

A few small (<250 μm) off-white fragments of the contact material were transferred individually on the tip of a sharp tungsten needle to the diamond plate (figures 7, 8) of a SensIR DuraScope[®] attenuated total reflection (ATR) apparatus that was placed in the sample compartment of a Nicolet 860 Magna FTIR at the California Institute of Technology.



Figure 7. The contact material on the diamond plate of the ATR accessory. Photo by G. Rossman.

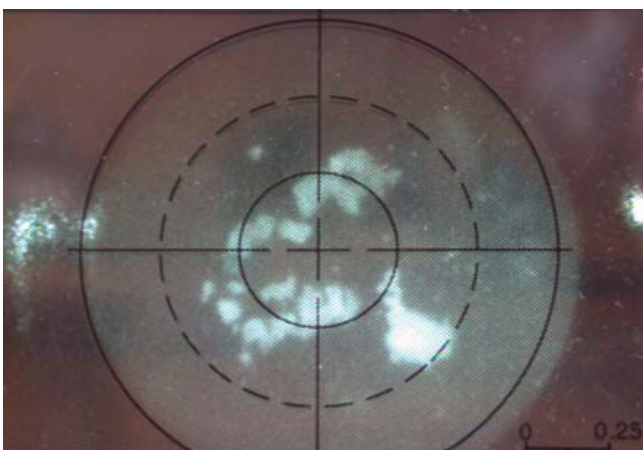


Figure 8. Video screen-shot of the white contact material adjacent to the andesine crystal on the ATR diamond sampling area. Photo by G. Rossman.

In addition, a portion of the porous matrix obtained about 1 cm away from the andesine crystal was also examined. The spectra of both the material in contact with the andesine and the matrix away from the andesine showed calcite plus a minor apparent silicate component. The most important difference between the matrix adjacent to the andesine and that further away was the strong contribution of organic material in the adjacent component, as indicated by C-H absorptions near 2900 cm^{-1} (figure 9). While not absolute proof of an assemblage, this is consistent with the presence of an organic binder used to attach the andesine to the matrix.

We decided to sacrifice one large matrix specimen with the hope of gaining more information about the origin of these specimens (figure 10). A specimen that showed two samples of andesine was broken apart with two strokes of a small hammer, but no andesine was found inside. The andesine samples originally visible on the surface were both broken out of the matrix, and one of them had a flat cleavage surface (figure 11) that left a well-preserved imprint in the contact material where it was attached to the matrix (figure 12). This area had a fine texture that was somewhat glassy, and completely unlike the surrounding matrix (figure 13). It did not bear any resemblance to a natural material.

Some of the specimens had fibers embedded in the matrix and in the contact material (figure 14). In one specimen in particular, the fibers were translucent, blue and flexible. Most of these fibers were buried in the contact material, but one stood up from the matrix (figure 15). Raman analysis of this fiber acquired a weak signal with a best match to nylon. Unfortunately the fiber melted when exposed to the laser, even after the power was lowered and the laser frequency was changed. Eventually the fiber was completely melted. We concluded that the fiber was man-made and could not have occurred naturally in the specimen. Further examination also revealed parts of insects embedded in the matrix (figure 16).

To determine if other components such as nylon fibers, or other minerals were present in the main carbonate matrix rock, about 1/2 gram of the main carbonate matrix was separated from a location away from the andesine crystals. This specimen was dissolved in dilute hydrochloric acid at room

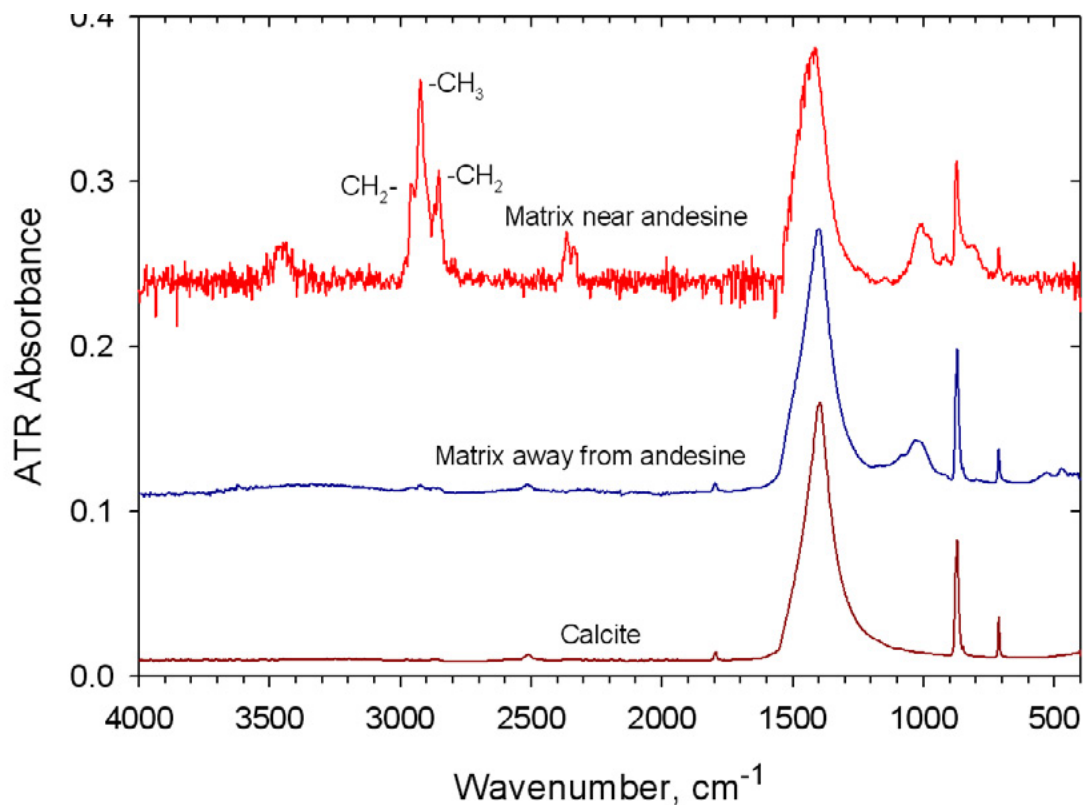


Figure 9. Infrared spectra of a calcite standard (bottom), the matrix away from the andesine (center) and the white contact material adjacent to the andesine crystal (top).

temperature until all bubbling ceased. A brown residue was centrifuged multiple times in de-ionized water to remove traces of acid and dried in air. The ATR spectrum of the residue proved to best match that of an illite-montmorillonite mixed layer clay and was close to the spectrum of pure montmorillonite. The clay component accounts for the weak, sharp band near 3620 cm^{-1} in the distant matrix sample, and much of the absorption in the 1030 cm^{-1} region. There is a weak absorption from organic material in the extracted clay component, but it is proportionally much less intense than the CH bands in the 2900 cm^{-1} region of the matrix adjacent to the andesine.

The only other components noticed in the centrifuged residue were a few half-centimeter long fibers of blue-green algae. Such fibers are not unexpected from a porous material found at the earth's surface.

The totality of our observations strongly suggests that the matrix specimens were manufactured. None of the above observations point to a natural occurrence. In addition,

no specimens of this kind were seen by team members who visited the reported mine sites in Tibet.

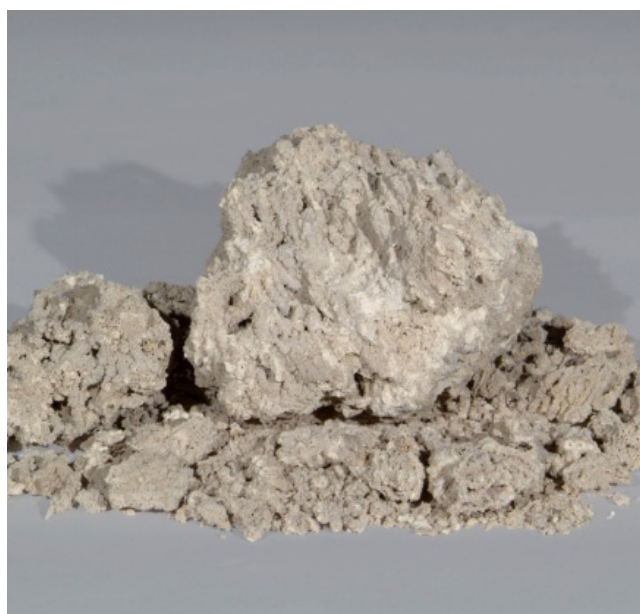


Figure 10 – The matrix was very friable and easily fell apart with a few blows from a small hammer. Photo by D. Mengason.

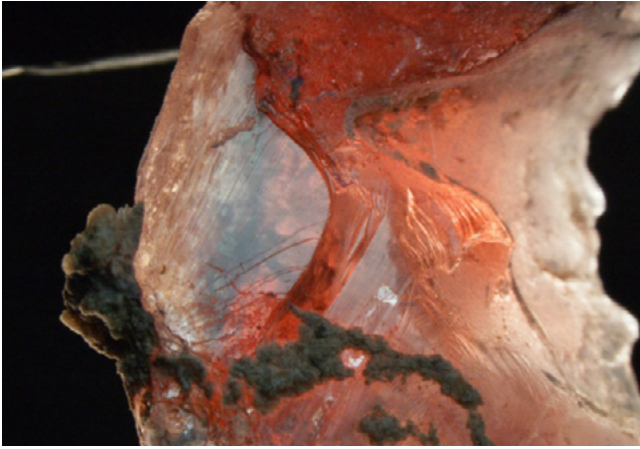


Figure 11 – One of the pieces of andesine that fell out of the matrix had a couple of cleavage planes visible on the surface which allowed us to locate the exact point where it was positioned in the matrix. Photomicrograph by S. F. McClure. Field of view 4.5 mm.



Figure 12 – This image shows an area in the matrix that formed an exact cast of a portion of an embedded piece of andesine which contained several cleavage planes. Photomicrograph by S. F. McClure. Field of view 4.5 mm.



Figure 13 – The area around where the andesine had been attached showed a fine grained structure and had a somewhat glassy appearance that was entirely unlike the rest of the matrix. Photomicrograph by S. F. McClure. Field of view 4.5 mm.

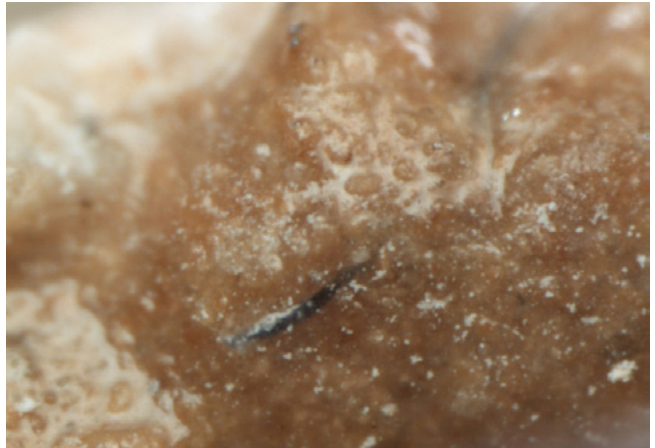


Figure 14 – Blue fibers were seen embedded in the contact material in one specimen. Photomicrograph by S. F. McClure. Field of view 0.9 mm.



Figure 15 – One fiber stuck out of the matrix, allowing us to see that it was translucent and flexible. The tip of the fiber can be seen to be rounded, which was caused by melting due to the energy of the laser of the Raman spectrometer. Ultimately the fiber was destroyed trying to identify it. The closest match we obtained (albeit a poor one) was for nylon. Photomicrograph by S. F. McClure. Field of view 1.1 mm.



Figure 16 – Several of the pieces of matrix had insect parts embedded in them. In this case it appears to be a leg. Photomicrograph by S. F. McClure. Field of view 3.0 mm.

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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.