Provenance studies on raw garnets from the Zillertal (Tyrol), Ahrntal (South Tyrol), and Radenthein (Carinthia)

S. Wagner[1], B. Zerobin[2], R. Köchl[3], P. Tropper[1], G. Goldenberg[2]

[1]Institute of Mineralogy and Petrography, University of Innsbruck
[2]Department of Archaeologies, University of Innsbruck
[3]Department of History and European Ethnology, University of Innsbruck
e-mail: simon.wagner@uibk.ac.at

There is evidence of the use of the mineral garnet as a gemstone in jewellery since the early Middle Ages. In the Alps, too, garnet is still used today in the form of traditional costume jewellery, especially the garnet variety almandine. From the middle of the 19th century, garnet mining began in the Zillertal, Ahrntal and Radenthein, of which all three remained important sites until the early 20th century. However, due to the export to the gemstone-cutting factories in the Czech Republic at the time, the raw garnets lost their actual origin and were henceforth traded as "Bohemian garnets". Nevertheless, a chemical differentiation and determination of origin is possible even in this state with suitable analytical methods (EPMA, micro-XRF, etc.). On a macroscopic level, it is not possible to distinguish visually between the different garnet deposits. The most significant features are the size and colour of cut garnets, since the true Bohemian garnets often only measure a few millimetres and show a more intense red colour than alpine garnets. A further criterion for distinguishing between the different alpine deposits can be achieved via the individual inclusion pattern, which can be attributed to the different conditions of garnet formation and differing host rock composition. Typical inclusions of Zillertal and Ahrntal garnet are, for example, chlorite, apatite, zircon, quartz, ilmenite, and epidote. In contrast, garnets from Radenthein show oriented growth, which is typically seen with the ilmenite and rutile inclusions. The clearest differences are due to chemical differences in the composition of the garnets, which can also be attributed to different formation conditions (P-T-X). Typically, these chemical differences can be clearly visualized by plotting certain oxides against each other. This method has proven to be very effective in distinguishing garnet deposits on a global scale and therefore forms the basic discrimination method in provenance studies (e.g. Then-Obłuska et al. 2021). On a local scale apparent chemical differences are only visible to a limited extent. However, the use of compositional data analysis allows a clearer distinction between the different alpine garnet deposits. In the case of chemical composition, certain conditions must be met to achieve a successful evaluation of discrimination features. With the help of software like *CoDaPack 2.0* (Comas-Cufí & Henestrosa 2011), these analyses can be carried easier and allow therefore a better differentiation between the different garnet deposits within Austria. Applying PCA on this big dataset, consisting of samples directly from the deposits and the former warehouse in Zell am Ziller, clearly shows that the biggest variance in the data set is produced by the three oxides MgO, MnO and CaO. By plotting these in a ternary diagram five different groups can be identified.