

EGU21-2423

<https://doi.org/10.5194/egusphere-egu21-2423>

EGU General Assembly 2021

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Single and multi-phase inclusions in garnets from the Lešnica alluvion in the Internal Dinarides, Serbia

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Inclusions in garnets from the river Lešnica alluvion (Cer mountain area, Serbia), were investigated in an effort to study their distribution within the garnet host and to estimate the mechanism of their origin. Garnets are often occurring in the Lešnica alluvion in a form of loosely separated crystals with preserved crystalline forms and as mildly rounded broken grains [1]. Their mineralogical determination was previously published by Milošević et al, [1]. Crystals, that have been extracted and separated from the sandy fraction, have exhibited the presence of various types of inclusions in their structure. Single and multiphase inclusions in the garnets were examined optically by petrographic methods followed by SEM-EDS method, applied for the chemical analyses of the individual inclusion, and LA-ICP-MS applied to determine distribution and content of trace elements in the host garnet.

Results from SEM-EDS method show that garnets are of the spessartine-almandine type with the incorporation of irregular inclusions determined as rare earth elements (REE) minerals (monazite, xenotime, columbite-tantalite) and accessory minerals that usually incorporate REE (titanite, apatite, and zircon) together with uranium oxide minerals. Other single-phase inclusions are often quartz and rutile. Size of inclusion varieties from grain to grain, between 5 and 40 μm , while their distribution doesn't follow any pattern, random distribution. It has been noted that zircon and uranium oxide minerals are often found coupled and as multiphase inclusions while monazite, xenotime and columbite-tantalite minerals are observed as separate, single, inclusions. Chondrite normalized REE in the host garnets plotted on spider diagram show extreme depletions of large ion lithophile elements (LILE) and enrichment in high field strength elements (HFSE), with negative Ce, Nd and Eu anomaly. Single-phase and multiphase inclusions that are occurring in the same garnet host with a random distribution are suggesting different genetic relations.

[1] Milošević M., Kostić B., Vulić P., Jelić I. 2019. Garnets from river Lešnica alluvion, mountain Cer. II Kongres Geologa Bosne i Hercegovine sa međunarodnim učešćem, Pp. 306-311