Oscillatory zoning fahlores from Au-Ag epithermal deposits

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Results

Oscillatory zoning was found in tellurian fahlores (goldfieldites) $[(Cu,Ag)_{10}(Fe,Zn)_2(Te,Sb,As)_3(S,Se)_{13}]$ from three epithermal Au-Ag deposits: Prasolovskoe, Ozernovskoe (Kamchatka-Kuril arc, Russia), and Elshitsa (Sredna Gora zone, Bulgaria). Two types of oscillatory zoning were revealed.

(1) Multiphase (or heterophase) with successive deposition of different minerals or mineral assemblages e.g. Elshitsa where there is regular alternation of goldfieldite bands (Te 2 to 3.2 apfu) with bands (1-2 to 50-100 µm) of tellurian-tennantite (Te 1.5 to 2 apfu) with abundant inclusions of native tellurium. At Prasolovskoe there are “chains” of hessite grains that occur within goldfieldite with a period of 10-20 µm.

(2) Monophase oscillatory zoning reflects element fluctuations in the chemical composition of a mineral. At Elshitsa it is represented by variations of Te from 2.3 to 3.2 apfu and As from 1.8 to 0.7 apfu with a period of 2-3 to 10 µm. At the Ozernovskoe deposit Te ranges from 1.25 to 2.5 apfu, and Sb from 0.86 to 1.33 with a period of up to 20 µm while As increases from 0.75 to 1.63 apfu.

Discussion

The number of such zones in grains with multiphase zoning is usually the same for all crystals in the sample which means that multiphase zoning was caused by an external factor, e.g. due to fluctuation of H_2S and O_2 activities in the solution, and can be described by the equation:

$$Cu_{12}As_2Te_2S_{13} + 2.8Te^0 + 2.6H_2S + 0.4H_2O + 2.8O_2 = 1.2Cu_{10}Te_4S_{13} + 2As(OH)^0_3$$

Monophase zoning is caused by an internal factor, e.g. by the difference between velocities of absorption of any component and its diffusion in the growing zone of the crystal. Since such a zoning occurs only in non-stirred solutions and can indicate local stagnation of the fluid.

Conclusions

Oscillatory zoning can be caused by both external and internal mechanisms and contain important information on mineral forming conditions.

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References

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Sapphirine-bearing assemblages: Assessment of experimental data and thermodynamic properties, and metamorphic conditions

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Experimental data involving sapphirine have been critically assessed, and the results show that thermodynamic descriptions derived on their basis and employed for estimating metamorphic conditions remain ambiguous and require further constraining with reversed equilibrium experiments. Thermodynamic properties of the sapphirine solid solution end-members have been optimised to make the theoretical stability fields of critical assemblages Spr + Qtz, Spr + Ky, and Spr + Ol consistent with observations from the natural occurrences. The Spr + Qtz assemblage widely recognised as indicative of the ultrahigh-temperature metamorphism has been found to survive a temperature decrease significantly below 900°C. The Spr + Ky assemblage likely implies a relatively high-pressure metamorphism at still lower temperatures, while the Spr + Ol assemblage may form in rocks only under specific conditions of a very low activity of water in a rather narrow temperature range. Estimation of an influence of changing *P-T* conditions on the sapphirine composition has shown that, in a fixed assemblage, this mineral must become more aluminous with increasing pressure and more siliceous with increasing temperature.

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