The study of microorganisms in the natural quartz fluid inclusion

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The fluid inclusion (12 x 28 μm), which presumable contains microorganisms (we will call them bacteria) had been studied from 1985. This inclusion was classified as a secondary inclusion as it is located in the intersecting fissure within the quartz crystal from metamorphic rock, i.e. amphibolite of Ladoga region, Russia. The inclusion contains aqueous solution, a vapour bubble (about 10 vol.%) and several dark elongated phases with a length between 2.5 - 3.5 μm and a thickness between 0.6 - 0.8 μm. These phases are immovable at room temperature, but after freezing and subsequent thawing of the aqueous solution a chaotic movement in the inclusion is observed. This movement does not occur only in a single plane of the inclusion, it takes place in the whole volume thus the quantity of particles can not be accurately counted. Up to 13 - 14 of those phases are observed in the field of vision. The velocity of movement gradually diminishes up to a complete stopping during different time intervals in different observations. The phenomenon is being reproduced every time after the fluid inclusion was frozen. Such freezing was performed about 100 times during last 25 years. The duration of bacteria movement was found to decrease from 10 days in 1987 up to about 24 hours beginning from the end of 2009 until now. Thus, it could be assumed that the bacteria movement is not a result of physical processes such as the Brownian motion movement.

The aqueous solution in this fluid inclusion freezes at -30 °C, with the complete disappearance of the vapour bubble and the ice occupies the complete volume of the inclusion. This indicates that the liquid has a low salinity. After heating, the ice disappears completely at +2 °C within the metastable region, stimulating the intensive bacteria movement. At slow cooling down to -28 °C, the movement is observed down to the freezing temperature of -30 °C. After thawing the movement of bacteria was also observed in all other experiments. In 2010 the inclusion was stated at +4 °C during 24 hours, but the duration of bacteria movement did not increase.

During heating the inclusion up to the homogenization temperature (gaseous bubble disappears at +130 °C) the bacteria movement was not slowed down but perhaps accelerated. The movement was practically the same at the temperature of inclusion heterogenization (+106 °C). During the homogenization experiment, where the bacteria do not move, it was found, that after heterogenization they began to move, but substantially less actively than after freezing.

Such behaviour of microorganisms in fluid inclusions was not observed in any objects and never reported in publications. But some data on moving particle observations of the above mentioned type and dimension is interpreted as microorganisms activity and can be found in Bargar et al., 1984 and 1985. The particles were observed in quartz crystals from the depth of 102.1 m obtained in bore holes in Yellowstone National Park. The authors assumed that the microorganisms (bacteria?) were incorporated some months or even years before the inclusions were studied.

The bacteria studied in our experiments are presumably rather ancient, but the dating could not be performed accurately. If the bacteria were enclosed in a obscured space for a long time, their living products (CO_2 or other gases?) could be accumulated and lead to decrease of their activity. The freezing could be responsible for the formation

of clathrates and the temporary decrease of gas concentration inside the inclusion succeeding the bacteria activity. The restoration of gas-liquid equilibrium inhibits the living activity of microorganisms. The un-reversible accumulation of gases in the inclusion could be interpreted as the cause of gradual decrease of bacteria activity duration in the cryometric experiments. Our knowledge on the microorganism existence within the obscure space could be markedly extended if our hypothesis is valid.

The bacteria activity during freezing, thawing and heating experiments was documented by a vision camera.

This study was supported by RFBS (project 10-05-00209).

REFERENCES

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