High-pressure stability of synthetic $Al_{63}Cu_{24}Fe_{13}$ icosahedral quasicrystal

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Quasiperiodic crystals are solids characterized by quasiperiodic translational order and a discrete point group impossible for ordinary periodic crystals [1]. Among synthetic quasicrystalline solids, icosahedral-$Al_{63}Cu_{24}Fe_{13}$ is of particular interest since it is representative of icosahedrite, the first quasicrystal found in nature [2, 3]. Although an extraterrestrial origin has been recently established for icosahedrite [4], pressure and temperature conditions at which the mineral would be stable are still not clear. Previous studies showed that synthetic AlCuFe quasicrystals do not undergo any phase transitions over pressures up to 35 GPa (at room temperature) [5] and over a temperature range of 500-870 °C at ambient pressure. However, no data are available for $Al_{63}Cu_{24}Fe_{13}$ quasicrystal at high temperatures and pressures.

We have performed *in situ* high-pressure synchrotron X-ray diffraction experiments under quasi-hydrostatic conditions (neon pressure medium) using diamond anvil cell technique up to 51.5 GPa (in both compression and decompression) to investigate the possible structural evolution of the synthetic analogue of icosahedrite. We also performed a series of quenched experiments with multi anvil to determine the thermal stability of $Al_{63}Cu_{24}Fe_{13}$ at different isobars (between 3 and 20 GPa) and employing different capsule materials to intrinsically buffer the oxygen fugacity.

Preliminary results from *in situ* X-ray diffraction data collected at ambient temperature confirm that the high degree of translational order for the $Al_{63}Cu_{24}Fe_{13}$ icosahedral quasicrystal is retained at much higher pressures than previously reported.

Results from this study will improve our knowledge regarding the origin of icosahedrite in nature and provide constraints on the pressure and temperature conditions for its formation.

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Impact of anthropogenic land cover changes (ALCC) on dust particle emissions and associated impact on radiation

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Mineral dust particles are usually considered as 'natural' aerosols. Human activities can however affect emission of dust particles by altering land properties or through an increase in desertification associated with climate change. Changes in wind speed due to climate change also alter the amount of dust particles emitted in the atmosphere. The goal of this work is to estimate the extent to which human activities contribute to dust emissions and how this has changed since the pre-industrial time taking into account both climate change and ALCC.

For this purpose, we use the global aerosol-climate model ECHAM6-HAM2.1, in which a new method to calculate potential dust source areas was implemented. This allows us to quantify emissions from agricultural sources and to account for past and future land cover changes. The results from the simulation using the new method compare relatively well to measurements and data available in the literature, indicating that the new approaches allows a reasonable representation of today's dust load and providing confidence into the new method.

In a 'best guess' simulation, where we consider the attempts of farmers to prevent ground erosion, we find that nearly 10 % of today's dust particles are emitted globally from agricultural sources. But agricultural dust sources are not necessarily new dust sources. Often natural grass or shrub land, where emissions of dust particles can take place, were converted into agricultural land. We then account for ALCC between 1850s and 2000s in the model system and simulate emissions under different climate conditions. The contribution of ALCC on changes in dust emissions between pre-industrial times and today is estimated. Further an estimate of the changes in radiative fluxes due to dust particles emitted from agricultural sources including both the direct and indirect aerosol effect is provided.

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