

News Notes

Atmospheric Sciences

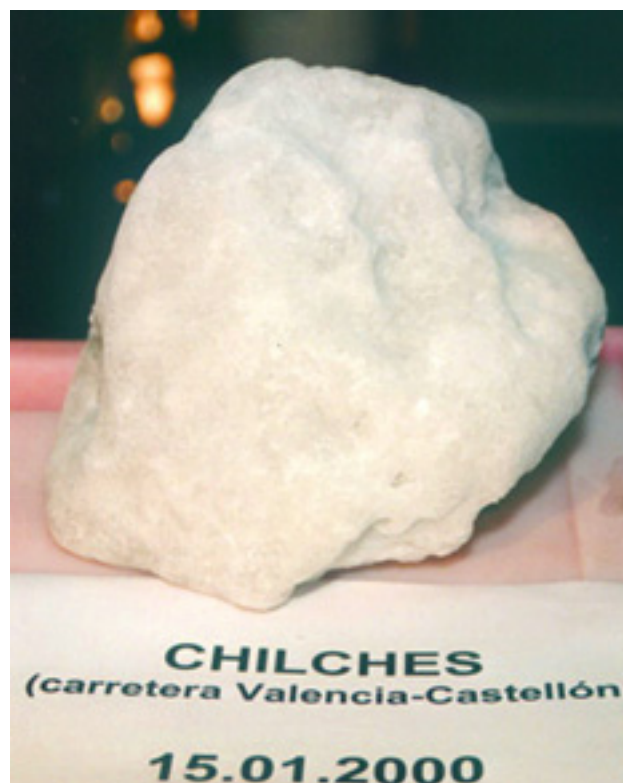
Hailstones fall from clear Spanish skies

On Jan. 8, news spread through the media in Spain that a chunk of ice fell from clear skies and hit a car in Tocina, a village close to Seville. The piece broke into two pieces, one weighing 1.2 kilograms and the other 1.7. Between Jan. 8 and Jan. 31, at least 50 such falls were reported.

Documented references of blocks of ice falling from clear skies go back to the first half of the 19th century (e.g. 1829 in Córdoba, Spain: 2 kg; 1851 in New Hampshire: 1 kg). Recent cases include a 9-kilogram, fall in Batley, West Yorkshire in 1991. Probably the best-documented fall of an ice chunk was April 2, 1973, in Manchester, England. The block weighed 2 kilograms and consisted of 51 layers of ice. Its origin was not determined.

Though some of the recent falls in Spain have been confirmed as practical jokes perpetrated after initial reports of the phenomenon — people froze large quantities of tap water and left the blocks of ice close to a public area or road — we have verified the authenticity of nine falls (more than 10 kilograms of ice) that occurred from Jan. 8 to Jan. 17.

Chemical and isotopic analyses were performed in five of the specimens. Our results offer evidence of chemical and isotopic heterogeneity (even within each block), with large densities of ions — up to five times larger than normal meteoric waters — and



This chunk of ice from Chilches (in eastern Spain) weighed four kilograms and measured 20 by 26 centimeters. Martinez-Frias et al.

corresponding to solutions of halite, calcite, anhydrite and quartz or feldspar aerosols.

The distribution of the samples on Craig's meteoric water line suggests either a variation in condensation temperature or isotopic exchanges during the formation of each ice chunk. These data, together with the high frequency of the events, indicate that the chunks aren't micrometeorites and didn't come from aircraft. They may result from an atmospheric phenomenon.

A hailstone is a product of the updrafts and downdrafts that develop inside the cumulonimbus clouds of a thunderstorm, where supercooled water droplets exist. The change of droplets to ice necessitates not only a temperature below 0 degrees Celsius, but also a catalyst in the form of tiny particles of solid matter that become freezing nuclei. Continued deposits of super-cooled water cause the ice crystals to grow into hailstones. Hailstones have been found as large as grapefruits and weighing up to 7.5 pounds.

The possible explanation for how the recent ice chunks form may hinge on the classical nucleation and growth processes. We assume that at the high region of the atmosphere (i.e., 6 kilometers) the vapor water saturation may be near equilibrium. It is well known that both the energy of nucleation and the critical nuclei that can eventually grow tend to infinity if saturation is close to one. Therefore the ice could not be formed under these conditions. However, if conditions for extra cooling exist — large concentrations of ions, aerosols, etc — then the nucleation energy reduces (heterogeneous nucleation) and the nuclei that can grow are formed. Another possibility could be that a crystallite from the lowermost stratosphere enters a region of humidity, where it begins growing.

Ozone distribution maps from NASA show that, on Jan. 5, a thin jet of ozone depression passed through all the areas in Spain where the ice falls took place. It is commonly posited that global warming and ozone depression are linked. Despite the fact that the greenhouse effect leads to an increase in the global mean surface temperature, it leads to cooling in the stratosphere. Perhaps the aforementioned nucleating crystallites enter the upper troposphere. There, where humidity is more abundant, they start growing, evidencing that the greenhouse effect is beginning to show. We suggest paying more attention to the fall of these unusual chunks of ice, which could be indicating that changes are taking place in the atmosphere.

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