Are Carbonado Diamonds Out of This World?

Carbonado diamonds are shiny, gray to black, rounded, relatively porous masses of fine-grained diamond, mixed with graphite and other rare minerals. They were first found in 1843 in placer deposits in Bahia, Brazil. Amazingly, these aggregates of interlocking grains are slightly harder than coarser diamond crystals. So, although not at all gemmy, they became prized for their use as an abrasive. Although most are from Brazil, carbonado finds have also been made in widely scattered localities such as Venezuela, Borneo, the Central African Republic and Russia. The carbonados from these locations also have a lot of chemical similarities, such as their carbon and nitrogen isotopes, suggesting a common origin. They are also quite different from ordinary coarse dark diamonds, generally referred to as "bort". Carbonado has never been found in kimberlites and lamproites, which are the usual host rocks for diamonds. It is only found in sediments or sedimentary rocks that are made of fragments brought in from elsewhere and reworked and redeposited by rivers and other surface processes. What could be the source of this strange material?

One clue to carbonado’s origin is the presence in these rocks of very odd minerals such as silicon carbide, pure titanium metal, pure silicon metal and iron-chromium alloy. Such materials form only under extremely reducing conditions. Such conditions may occur very deep in the earth but carbonado has never been found in the rocks that originate at those depths. A second way to get such environments on earth is around certain very acidic volcanic vents. But carbonados have never been found in regions with such environments either.

The other possible source for carbonado involves meteors. Impact of such large asteroid-size impactors can produce the pressure necessary to convert terrestrial carbon to diamond. This has occurred in several places, including the famous Popigai crater in Russia. Here an enormous impact about 35 million years ago produced jillions of microscopic diamonds scattered in the rock. Impact diamonds are very tiny, but carbonado fragments can weigh more than a pound. In addition, some high-pressure features expected in impact rocks are missing in carbonado.

Recent research suggests that the carbonado samples may not be formed by a meteorite impact - they may BE fragments of a meteorite. This work, done by a scientific team lead by Jozsef Garai of Florida International University, was a thorough infrared analysis of carbonado. They found distinct geochemical features widespread in carbonado that do not resemble natural earth materials at all, even those formed deep in the earth's mantle. The findings pointed to formation in a very hot region dominated by abundant hydrogen. They propose such a place is an "interstellar environment" - a star or planet outside our solar system. Carbonado most resembled pre-solar diamonds found in meteorites as well as synthetic diamonds produced on earth by carbon vapor transport. Some of the hydrocarbon impurities in carbonado resemble those seen in spectral studies of stars and nebula. An intriguing possibility is that diamonds could be formed as part of the last stage of common star's life, when the star has used up most of its hydrogen and helium and is cool enough for some of the components to condense and crystallize. This would be a natural analog for industrial diamond growth by carbon vapor transport. These are part of the so-called "crystalline white dwarf stars" that astronomers are just beginning to study. Were these to break up, fragments would disperse and some could wind up on earth. Being so refractory, they would survive coming through our atmosphere, and if the fragments were small, their impact on the surface would not involve the high-pressure stresses experienced by larger objects.

While the origin of carbonado is still not proven, it's neat to think that fragments of a cooled star could survive, find their way across billions of miles to earth and be preserved for us to find. These would truly be "falling stars."

-Dr. Bill Cordua, University of Wisconsin-River Falls

References:

