The uniformitarian challenge of ultrahigh-pressure minerals

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Ultrahigh-pressure (UHP) minerals, as well as high-pressure (HP) minerals, have been increasingly discovered on the earth's surface over the past 40 years or more. These minerals have caused much frustration to uniformitarian scientists because such UHP minerals imply metamorphism at high pressures, but the minerals are now located in a low-pressure environment at the earth's surface.

UHP minerals are believed to have originated predominantly from continental crust. Uniformitarian scientists have therefore concluded that *continental rocks* have been forced downward and then *rapidly* exhumed. Continental crust is significantly lighter than mantle rock, so it is difficult to force these rocks downward into more dense rocks. Furthermore, the rocks must remain at low temperature while descending into a much hotter environment. A slow exhumation should cause what is called reverse metamorphism and destroy the UHP mineral. Each new discovery of UHP minerals has pushed the depth of descent and assent farther downward, causing a predictable cycle of uniformitarian disbelief and acceptance.[1] A paradigm change has occurred with UHP minerals that continues today:

> 'The story of ultrahigh-pressure metamorphism (UHPM) is a confused mixture of surprising, sometimes spectacular, discoveries and emotional reactions. Surprisingly, the process has been a repeating cycle of disbelief followed by confirmation, with little evidence that the community response in a given cycle has learned from previous cycles.'[2]

The discovery of blueschist starts the paradigm change

The first HP mineral discovered was blueschist in the Franciscan Formation of northwest California.[3] The problem is that blueschist is stable at *high pressure and low temperature*. This was a surprise and implied unacceptably rapid descent and ascent rates. The uniformitarian geological community reacted in predictable fashion, 'Either the experimental results had to be incorrect or misinterpreted, or their application to Earth was flawed.'[4] The implications were rejected as impossible. After a flurry of activity and failed hypotheses, plate tectonics saved the day. It was postulated that blueschist was formed by subduction down to previously unbelievable depths of 20 to 50 km and then exhumed at similar subduction rates.

Blueschist is now found at over 250 locations around the earth from both ocean and continental paleoenvironments.[5] It is difficult to relate all these locations to current subduction zones. But, wherever blueschist is found, it is believed that it is the product of *fossil* subduction zones. Several tectonic models attempt to explain blueschist, but none of these models adequately explains the tectonic setting and timing of uplift.[6]

UHP minerals exhumed from deeper and deeper

In the late 1970s, garnet peridotite, a mantle rock, was discovered in the Swiss Alps with a suggested depth of exhumation from at least 120 km.[7] The same cycle of uniformitarian disbelief followed by acceptance ran through the geological community.

Other UHP minerals from the earth's continental rocks soon followed. Coesite, a high-pressure type of SiO_2 that was thought restricted to meteorite impacts, was found in the Alps and in eclogite, another HP mantle rock, from the Western Gneiss Region of Norway.[8] Coesite was later found at many other locations.

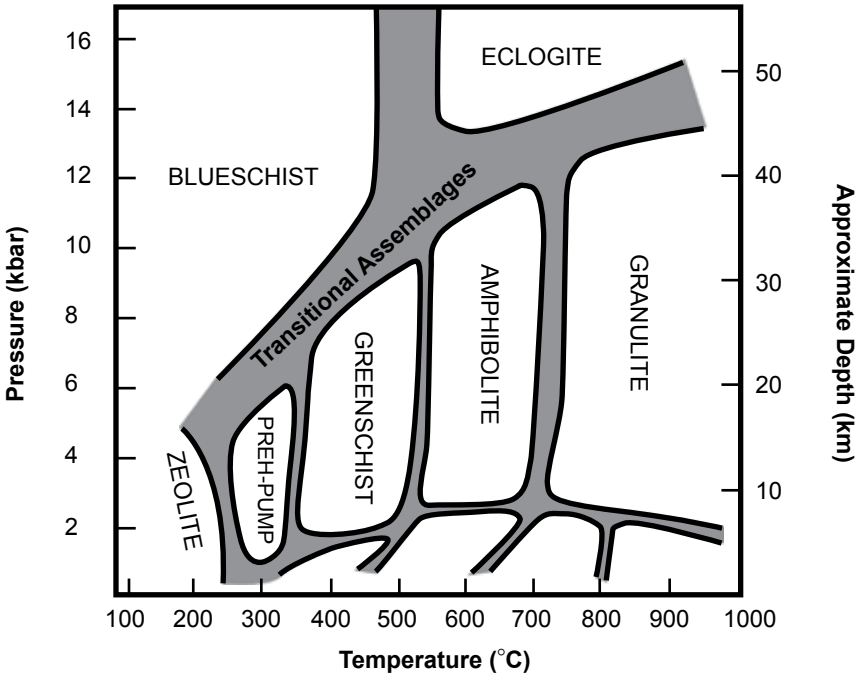
Microdiamonds, evidence of very high pressure, were first found in Kazakhstan, central Asia.[9] Microdiamonds, as well as UHP minerals, then turned up from locations all over the earth, including central China, Antarctica, Brazil, Europe, Mali, East Greenland, central Asia, the Himalayas and Indonesia.[10] Multiple outcrops in central China now extend across an east-west belt 4,000 km long.[11–13] Just recently, the only discovery of UHP minerals in the western mountains of North America was found in northern British Columbia.[14] It is interesting that rocks with the highest pressures are also commonly found in structurally high tectonic positions in mountain ranges.[15]

All these discoveries implied that continental rocks were rapidly forced to depths greater than 100 km and returned rapidly to the surface. However, continental rocks, being lighter than ocean rocks and the earth's mantle, do not subduct very easily.

'Rapid', of course, is defined within uniformitarian terms and is thought to be around 1.5 to 3.5 cm/yr.[16,17] However, these 'fast' rates are based on radiometric dating, which results in the belief that many processes on the earth operate at very slow rates. I wonder if lab results would verify rates of sinking and exhumation of a few cm/yr. A new result suggests that some UHP and HP minerals, such as eclogite, can form at low temperatures due to fluid flow in as little as 20,000 years with individual fluid flow events lasting about 10 years.[18,19] This is surprisingly fast in uniformitarian terms and will be controversial. However, radiometric dating methods and old age assumptions continue in this new result.

Uniformitarian geologists have brought out the idea of continental collisions to account for the data. However, how such radical vertical tectonics can occur with continental collisions remains enigmatic.[20] In fact 'clueless' is suggested from the following:

> 'As a consequence, thermomechanical insights inferred from P-T-t reconstruction and structural studies of high-pressure terranes have relentlessly failed to reproduce the trajectories and the velocity field of mass transport in the crust during the entire orogenic period and, most importantly, show no clue to the basic processes responsible for burial and rock exhumation and



Temperature-pressure diagram for various metamorphic facies, including the high-pressure blueschist facies.

their relation to the global velocity framework of plate tectonics.'[20]

That is not all. Analysis of UHP minerals suggests that some minerals had been driven down to depths of around 300 or 400 km and exhumed![21,22] A new cycle of disbelief then followed.

Based on ophiolites (believed to be old ocean crust and upper mantle), blueschists and UHP metamorphic terranes, it is claimed that subduction started on Earth in the Neoproterozoic time about 1 billion years ago, according to the uniformitarian timescale.[23] However, UHP minerals and microdiamonds are now found in the Paleoproterozoic (allegedly 1.8 billion years ago), suggesting to some researchers that subduction began back then.[24]

What do UHP minerals mean for Flood models?

UHP minerals present some exciting possibilities for Flood models, but we must be careful how we incorporate these minerals into the models, because of many unknowns and untested assumptions. Radiometric and uniformitarian, old age assumptions are highly associated with deductions of UHP minerals. There is the possibility that at least some UHP minerals are due to reactions with hot fluids. Another idea is that they are caused by tectonic overpressure, but the idea has been rejected by uniformitarian scientists because the magnitude of tectonic overpressure is thought to be too small.[25,26] However, in the catastrophic plate tectonic model and the meteorite impact model, tectonic overpressures may be able to cause UHP minerals. After all, coesite is also associated with meteorite impacts.

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