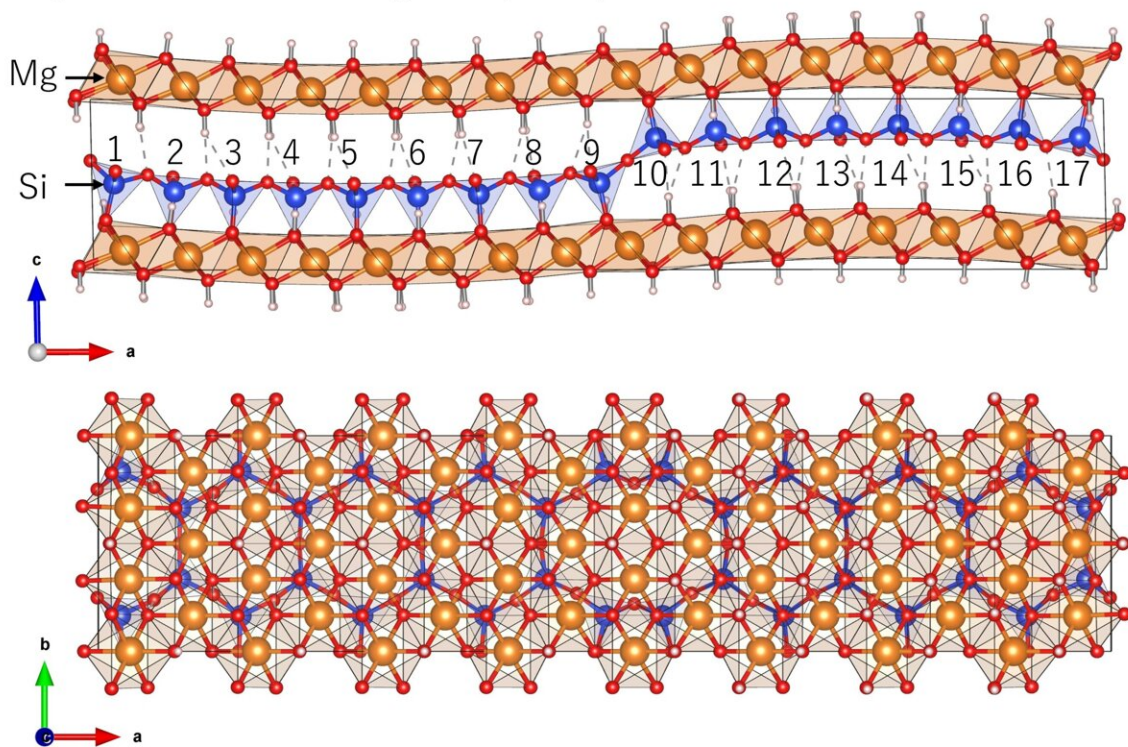


Investigations of the polysomatism of antigorite under pressure

July 5 2024

Crystal structure of antigorite ($m=17$)



The crystal structure of antigorite with $m=17$. The number of tetrahedra within one wavelength along the a-axis represents the m -value. Orange: Mg, Blue: Si, Red: O, Pink: H. Credit: Jun Tsuchiya, Ehime University

Antigorite is a type of serpentine, which is the most abundant hydrated

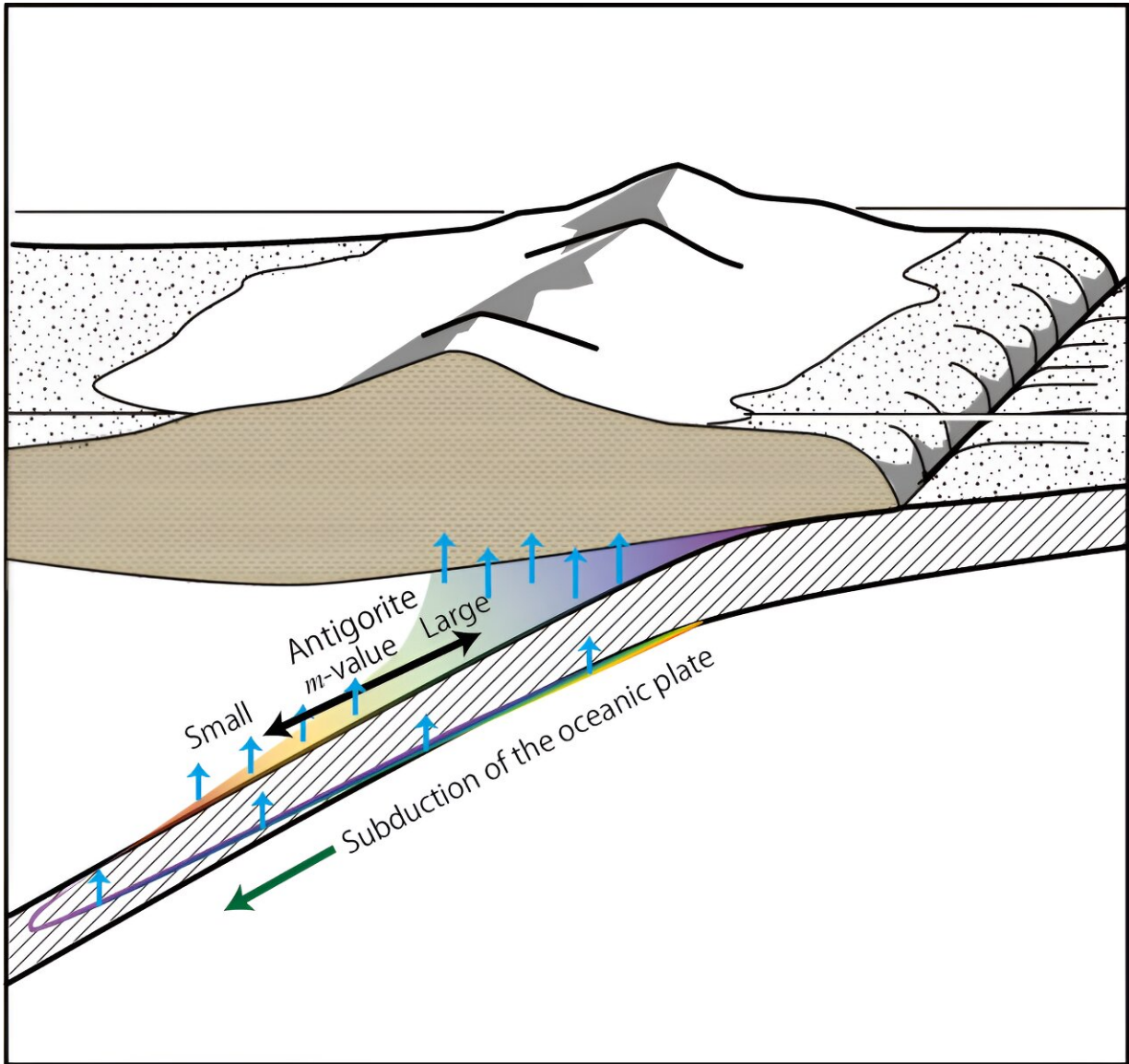
mineral on the Earth. It is widely believed that this mineral is the main carrier of water deep into the Earth in subducting oceanic plates. It has a wavy structure along the a-axis, and in nature, several polysomes with different m-values ($m=13-24$) have been identified (polysomatism).

The m-value is defined as the number of tetrahedra contained in one [wavelength](#), and is controlled by the difference in length between the octahedral layer and the tetrahedral layer.

This length is mainly determined by the size of the MgO_6 octahedra and SiO_4 tetrahedra, and is therefore expected to vary as a function of pressure and temperature. However, it is not well understood how the m-value of antigorite changes under the [high pressure](#) and temperature conditions in the Earth.

In this study, researchers used the first-principles method to calculate the [free energy](#) (enthalpy) of antigorites with different m-values ($m=14-19$) under pressure, and compared the stability of antigorites with different m-values. The study is [published](#) in the *Journal of Geophysical Research: Solid Earth*.

As a result, it was found that the m-value of the most stable antigorite gradually decreases. In other words, antigorite gradually dehydrates as pressure increases, changing into a structure with a shorter wavelength.



The present results indicate that the m -value of antigorite tends to decrease under high pressure. Therefore, the decrease in the m -value of antigorite is expected as the depth increases in subduction zones. Credit: Jun Tsuchiya, Ehime University

This suggests that the structure of antigorite in the oceanic lithosphere may gradually evolve into a polysome with a smaller m -value that differs from the antigorite observed under [ambient pressure](#) or near-surface

pressure conditions (i.e. $m=17$).

Such changes in m -values are accompanied by minor dehydration reactions. Changes in the amount of water in rocks and minerals due to the polysomatism of antigorite in [subduction zones](#) may affect the distribution of intermediate-depth earthquakes, such as those observed in the double seismic zone.

More information: Jun Tsuchiya et al, First-Principles Investigations of Antigorite Polysomatism Under Pressure, *Journal of Geophysical Research: Solid Earth* (2024). [DOI: 10.1029/2023JB028060](https://doi.org/10.1029/2023JB028060)

Provided by Ehime University

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