Stellar Metamorphosis: Titanium

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Abstract: Titanium is discussed and connected from young to old stars. Titanium's role in stellar evolution is still not completely worked out, but it is essential to create a foundational understanding of the element for future generations.

Titanium has the atomic number 22, and has 5 stable isotopes. The isotope ^{48}Ti is the most abundant, with 73.72%. Since stars form chemical compounds as they cool and evolve, per the chemical complexity principle which states:

"Chemicals increase in complexity on and near the surface of a star as it evolves."

http://vixra.org/pdf/1607.0467v1.pdf

We can expect that the titanium found on the Earth in the form of titanium dioxide to have formed when the Earth was a much younger hotter star, most likely late red dwarf down to late brown dwarf stages of evolution. Spectroscopically titanium oxide and vanadium oxide is observed in red dwarfs. This signals that the crustal material of a highly evolved star like the Earth, had its crustal material in simpler compounds formed in the high atmosphere, which then sunk to the interior to form the crust, along with other elements which can be considered impurities. What this also means is that red dwarf stars are far too young to have titanium dioxide in its mineral form, as is found on Earth as rutile, and other minerals. Young stars are just too hot to allow for mineral formation. Only old stars can possess titanium oxide/dioxide in its stable/solid form.

Titanium is the ninth most abundant element in the Earth's crust, .63% by mass. This means it plays a much larger role in determining the properties of a star's interior crust formation than does hydrogen, or helium. The majority of the hydrogen and helium escape back into interstellar space as stars evolve, leaving higher proportions of titanium in the interior of the star. This is directly observed in all stars that are evolved. It is found combined with oxygen so readily in nature because of oxygen's high electronegativity, as well as the fact that oxygen is the third most abundant element in young stars, apart from hydrogen and helium. Put simply, any titanium that the star contains will indeed, combine with oxygen, and form the dioxide. Only, the dioxide cannot readily form, only the oxide can, in younger stars such as red dwarfs, because they are too energetic still. The star needs to cool down more, to attach the second oxygen, to form the dioxide.

All old stars will contain titanium in their crusts. The amounts of the element containing ores will vary though, and will tell us more about how the star evolved. The Moon has lots of rich titanium ore, so there is something to be said about that. The Moon probably had its outer rocky layers ripped (ablated) away, exposing more of the titanium ore than Earth currently shows. One could guess then from observing the Moon's titanium ore and comparing it to Earth, in that Earth's ore probably increases in titanium by mass in the lower crust. Essentially, to get to heavier metals, and metals that have sunk and differentiated more during the Earth's earlier evolutionary periods, we just have to drill deeper.

More will be added to this paper in the future, as titanium is a fantastic element. There is a lot to learn when you realize that its role in stellar evolution (also known as planet formation) is much greater than astronomers and geologists realize. It composes the crust of highly evolved stars, and we're standing on one.