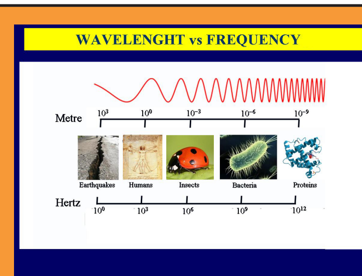
Distinguished Lecture in Solid Mechanics

Acoustic, Electromagnetic, and Neutron Emissions from Brittle Fracture and Earthquakes



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Piezonuclear fission reactions appear to be induced by pressure waves at very high frequencies (TeraHertz). They are often accompanied and revealed by the emission of neutrons, alpha particles, and electromagnetic waves. However, gamma rays and radioactive waste appear to be absent. Ultrasonic pressure waves may in turn be produced by the most common instabilities, such as fracture in solids and turbulence in fluids.

After the early experiments conducted at the National Research Council of Italy (CNR), soliciting with ultrasounds aqueous solutions of iron salts, the research group of the Politecnico di Torino has conducted fracture experiments on solid samples, using iron-rich rocks (granite, basalt, magnetite), marble, and other materials. Different types of detectors have demonstrated the presence of significant neutron emissions, in some cases by several orders of magnitude higher than the usual environmental background (up to 10 times from granitic rocks, up to 100 times from basalt, up to 1000 times from magnetite).

These studies have also been able to give an answer to some puzzles related to the history of our planet. It has been shown how the piezonuclear reactions that would have occurred between 3.8 and 2.5 billion years ago, during the period of formation and most intense activity of tectonic plates, have resulted in the splitting of atoms of certain elements, which were so transformed into other lighter ones. Since the product-elements, i.e. the fragments of the fissions, appear to be stable isotopes, all the excess neutrons are therefore emitted. Several of the most abundant chemical elements have been involved in similar transformations, like a part of magnesium that would have been transformed into carbon, forming the dense atmospheres of carbon dioxide (CO_2) and methane (CH_4) of primordial terrestrial eras. In a similar way, calcium depletion would have contributed to the formation of oceans as a result of fracture phenomena in limestone rocks.

Considering the entire life of our planet and all the most abundant chemical elements, it can be seen how ferrous elements have dramatically decreased in the Earth's Crust (-12%), as well as at the same time aluminum and silicon have increased ($+8.8\%$). An increment in magnesium ($+3.2\%$), which then transformed into carbon, has already been assumed as the origin of carbon-rich primordial atmospheres. Similarly, alkaline-earth elements have strongly decreased (-8.7%), whereas alkaline elements ($+5.4\%$) and oxygen ($+3.3\%$) have increased. The appearance of a 3.3% oxygen represents the well-known Great Oxidation Event, a phenomenon that led to the creation of life and the formation of oceans on the planet Earth.

These transformations, that have lasted for billions of years in the Earth's Crust, have been reproduced in the laboratory in a fraction of a second by crushing different rock samples. We were able to confirm, through advanced microchemical analyses, the most relevant compositional variations described above at the geological and planetary scales.

Even in the case of the other planets of the Solar System we are witnessing a series of experimental evidences that can be interpreted in the light of piezonuclear fission reactions. They are triggered by earthquakes in rocky planets and by storms in gaseous planets. In the Sun, for example, the drastic decrease in lithium appears to be due to the fission of the same lithium into helium and hydrogen.

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Lees-Kubota Lecture Hall

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Lecture followed by refreshments at 4 PM.

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