NEUTRON EMISSION FROM FRACTURE AND EARTHQUAKES

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NEUTRON EMISSIONS FROM EARTHQUAKES


As reported in the literature, an average thermal neutron flux up to $10^0 \text{ cm}^{-2} \text{ s}^{-1}$ ($10^3$ times the background level) was detected in correspondence to earthquakes with a magnitude of the 4th degree in Richter Scale (Volodichev N.N., et al. (1999)).

Global seismic activity and neutron flux measurements in the period 1974-1988. Laboratory of Geophysical Precursors, Oblast' Murmansk, Apatity, Kola Peninsula, Russia (Sobolev et al. 1998).
During the experimental analysis four test specimens were used:

- two made of **Carrara marble**, calcite, specimens P1 and P2;
- two made of **Luserna granite**, gneiss, specimens P3 and P4;
- all of them measuring 6x6x10 cm$^3$.

This choice was prompted by the consideration that, test specimen dimensions being the same, different brittleness numbers would cause catastrophic failure in granite, not in marble.
Specimens P1 and P2 in **Carrara marble** following compression failure.

Specimens P3 e P4 in **Luserna granite** following compression failure.
Brittle Fracture Experiment on granite specimen

Load vs. time and cps curve for P3 test specimen of granite.
# NEUTRON EMISSION FROM CAVITATION OF LIQUIDS AND FRACTURE OF SOLIDS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>NEUTRON EMISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LIQUIDS</strong> – Cavitation</td>
<td></td>
</tr>
<tr>
<td>Iron chloride</td>
<td>up to 2.5 times the Background Level</td>
</tr>
<tr>
<td><strong>SOLIDS</strong> – Fracture</td>
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<tr>
<td>Steel</td>
<td>up to 2.5 times the Background Level</td>
</tr>
<tr>
<td>Granite (Fe ~ 1.5%)</td>
<td>up to $10^1$ times the Background Level</td>
</tr>
<tr>
<td>Basalts (Fe ~ 15%)</td>
<td>up to $10^2$ times the Background Level</td>
</tr>
<tr>
<td>Magnetite (Fe ~ 75%)</td>
<td>up to $10^3$ times the Background Level</td>
</tr>
<tr>
<td>Marble</td>
<td>Background Level</td>
</tr>
</tbody>
</table>
Tectonic plate formation (~3.8×10⁹ years ago)

3.8 Billion years ago:
Fe (−7%) + Ni (−0.2%) =
= Al (+3%) + Si (+2.2%) + Mg (+2%)

2.5 Billion years ago:
Fe (−4%) + Ni (−0.8%) =
= Al (+1%) + Si (+2.3%) + Mg (+1.5%)
Localization of iron mines

Iron reservoirs
- More than 40 Mt/year
- from 10 to 40 Mt/year

Localization of Aluminum mines


The results of these quantitative analysis represent a direct evidence that piezonuclear reaction has occurred in the rock specimens.

\[
\text{Fe}^{56}_{26} \rightarrow 2 \text{Al}^{27}_{13} + 2 \text{ neutrons}
\]
Therefore, the Fe decrease (−3.0%) in biotite is counterbalanced by an increase in Al (+1.5%), Si (+1.2%), and Mg (+0.7%). Considering these evidences, in analogy to the previous results, it is possible to conjecture that another piezonuclear reaction has been occurred in the biotite crystalline phase during the tests:

\[ \text{Fe}^{56}_{26} \rightarrow \text{Si}^{28}_{14} + \text{Mg}^{24}_{12} + 4 \text{ neutrons} \]
Therefore, the Fe decrease (−4.0%) in olivine is counterbalanced by an increase in Si (+2.2%) and Mg (+1.6%). Considering these evidences, in analogy to the previous results, the following piezonuclear reaction is conjectured:

\[ \text{Fe}^{56}_{26} \rightarrow \text{Si}^{28}_{14} + \text{Mg}^{24}_{12} + 4 \text{ neutrons} \]
The Fe decrease (−28.0%) in magnetite is counterbalanced by an increase in Al (+10.1%), Mn (+2.2%), Si (+8.7%) and O (+6.7%). Considering these evidences, in analogy to the previous results, the following piezonuclear reactions are conjectured:

\[
\begin{align*}
\text{Fe}^{56}_{26} & \rightarrow 2\text{Al}^{27}_{13} + 2 \text{ neutrons} \\
\text{Fe}^{56}_{26} & \rightarrow \text{Mn}^{55}_{25} + \text{H}^{1}_{1} \\
\text{Fe}^{56}_{26} & \rightarrow \text{Si}^{28}_{14} + \text{O}^{16}_{8} + 2\text{He}^{4}_{2} + 4 \text{ neutrons}
\end{align*}
\]
The Ca, Mg and O decreases (−3.6%), (−0.4%) and (−9.0%) in marble are counterbalanced by an increase in C (+13.0%). It is possible to conjecture that the following piezonuclear reactions have been occurred:

\[
\begin{align*}
\text{Mg}^{24}_{12} & \rightarrow 2\text{C}^{12}_6 \\
\text{Ca}^{40}_{20} & \rightarrow 3\text{C}^{12}_6 + \text{He}^4_2 \\
\text{O}^{16}_{8} & \rightarrow \text{C}^{12}_6 + \text{He}^4_2
\end{align*}
\]
Magnesium depletion in the Earth Crust and Carbon concentration in the primordial atmosphere

The assumed virtual Mg increase (~3.5%) can be confirmed by the Carbon content in the primordial atmosphere:

\[
\begin{align*}
\text{Fe}^{56} & \rightarrow \text{Mg}^{24}_{12} + \text{Si}^{28}_{14} + 4 \text{ neutrons} \\
\text{Mg}^{24}_{12} & \rightarrow 2\text{C}^{12}_6
\end{align*}
\]

Assuming a mean density of the Earth Crust equal to 3.6 g/cm³ and a thickness of ~60 km, the mass increase in Mg (~3.5×10²¹ kg) implies a very high atmospheric pressure due to the transformed carbon.

Primordial atmospheric pressure due to piezonuclear C content = ~650 atm

Primordial atmospheric pressure reported by other authors = ~650 atm (Liu, 2004)

CALCIUM DEPLETION & OCEAN FORMATION
3.8 Billion years ago:
\[ \text{Ca} (-2.5\%) + \text{Mg} (-3.2\%) = \text{K} (+1.4\%) + \text{Na} (+2.1\%) + \text{O} (+2.2\%) \]

2.5 Billion years ago:
\[ \text{Ca} (-1.5\%) + \text{Mg} (-1.5\%) = \text{K} (+1.3\%) + \text{Na} (+0.6\%) + \text{O} (+1.1\%) \]
Calcium depletion in the Earth Crust and ocean formation

Global decrease in Ca (−4.0%) is counterbalanced by an increase in K (+2.7%) and in H₂O (+1.3%).

\[
\begin{align*}
\text{Ca}^{40}_{20} & \rightarrow \text{K}^{39}_{19} + \text{H}^1_1 \\
\text{Ca}^{40}_{20} & \rightarrow 2\text{O}^{16}_8 + 4\text{H}^1_1 + 4 \text{ neutrons}
\end{align*}
\]

Considering a mean density of the Earth Crust equal to 3.6 g/cm³ and an average thickness of ~60 km, the partial mass decrease in Ca is about \(1.41 \times 10^{21}\) kg.

Considering a global ocean surface of \(3.607 \times 10^{14}\) m², and an average depth of 3950 m, we obtain a mass of water of about \(1.35 \times 10^{21}\) kg.