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Red Wood Ant Mounds as Biological Indicators for Earthquake-bearing Fault Systems

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Geological findings from Southern Europe to Northern Scandinavia prove that there is a strong affinity of red wood ants for gas-permeable, young active, tectonic fault systems (Schreiber et al. 2009). These faults are more or less potential locations for earthquakes. The cause of this is not fully resolved. However, there are first indications, that geogenous gases ascending from faults play a decisive role. These gases cause a rise of temperature in a restricted area. The Formica rufa group is highly sensitive to least temperature rises. A further aspect could be that cavities within the faults are providing humidity close to the surface, which ants can use in very dry years. Furthermore, Formica shows physiological characteristics of respiration. Today's O2 concentration in the atmosphere appears to be too high for the respiratory system of Formica. Due to their cyclic, discontinuous breathing, the insects interrupt the O2 uptake to generate a semi-anoxic environment in their bodies with a high CO2 content to avoid oxygen toxicity in their cells (Hetz & Bradley 2005, Lighton 1988). Whether the higher CO2 concentrations provided by the gas permeable fault systems create an optimum nest climate, which meets the atmospheric composition of the Cretaceous with 10-fold CO2 concentration compared to nowadays, are discussed as one possibility. Then, the biological family of ants evolved.

In the volcanic West Eifel, a comprehensive investigation in an area with more than 1,100 square kilometers was successfully conducted to establish the correlation between red wood ant nest sites and tectonic fault systems (Berberich & Schreiber 2009). The Eifel is part of the Variscan folded Rhenoherzynikum which was tectonically sheared in Mesozoic and Cenozoic times according to multiple changes of principal stress directions. The current stress field with a NW-SE-trending main stress direction opens a pathway for geogenous gases and potential magmas following the same orientation. At the same time, variscan fault zones, which are part of a conjugated shear system, are reactivated. The mapping results of red wood ant nest sites showed clusters and linear arrays of more than 2,900 Formica nest sites. While the linear nest distribution correlate with strike-slip fault systems documented by quartz, ore veins and slickensides, the cluster represent intersection zones of two dominant fault systems. These intersection zones can be correlated with voids caused by crustal block rotation.

Due to the sub-recent volcanism (> 11,000 years) in the West Eifel, numerous mineral springs and mofettes arise on the fault systems. Gas samples taken from soil air, mineral springs and mofettes and the subsequent analysis of the geogenous gas concentration of CO2, Helium and Radon document reveal limiting concentrations for the distribution of nests sites and colonization. Striking is further the almost complete absence of nest sites in the core area of the Quarternary volcanic field. A possible cause can be found in occasionally occurring H2S in the fault systems, which is toxic at miniscule concentrations to the ants. Viewed overall, the results are showing a strong dependence on the distribution of red wood ant nest sites on the neogene tectonics in the Eifel.

References:

Berberich, G. and Schreiber, U. (2009): Detection of Gaspermeable Strike-Slip Faults by means of Bio-indicators (Hill-building Forest Ants) and Gas Analysis in the Volcanic West- and Hocheifel (Germany). Abstract. GV Annual Meeting 2009, Göttingen 5 – 7 October 2009, p.16.

Hetz, S. K. and Bradley, T. J. (2005). Insects breathe discontinuously to avoid oxygen toxicity. Nature 433, 516-519.

Lighton, J. R. B. (1988): Discontinuous CO2 Emission in a small insect, the formicine ant Camponotus vicinus. J. Exp. Brol. 134, 363-376.

Schreiber, U., Brennholt, N. & Simon, J. (2009): Gas permeable deep reaching fracture zones encourage site selection of ants. Ecological Indicators, Vol. 9: 508-517.