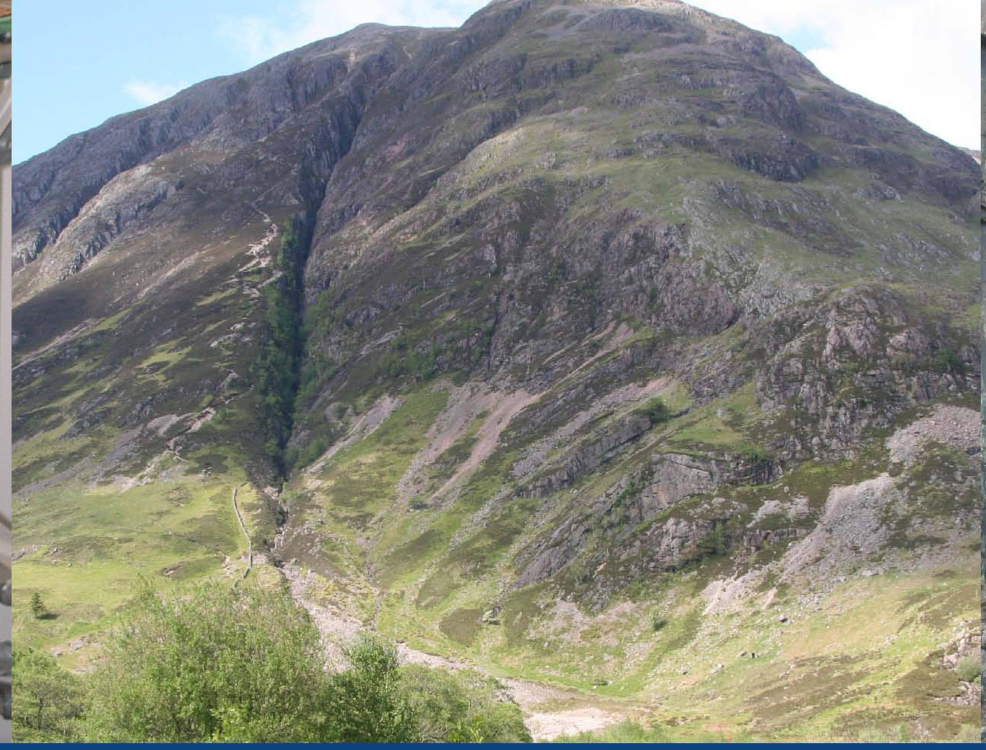
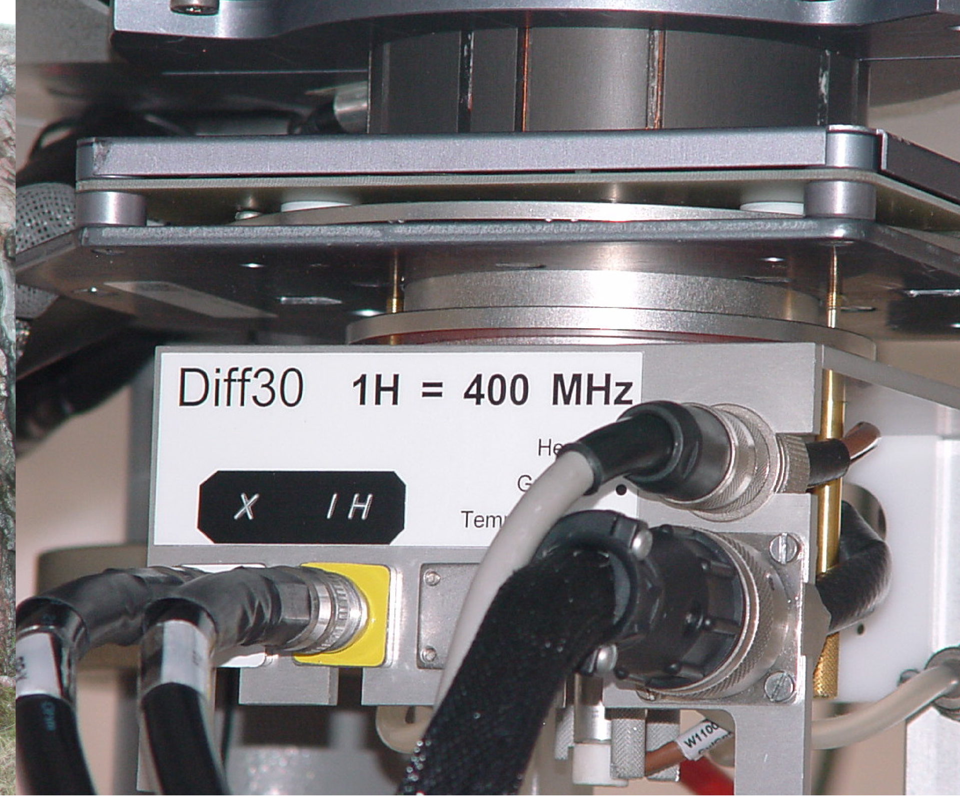




UNIVERSITÄT
DUISBURG
ESSEN

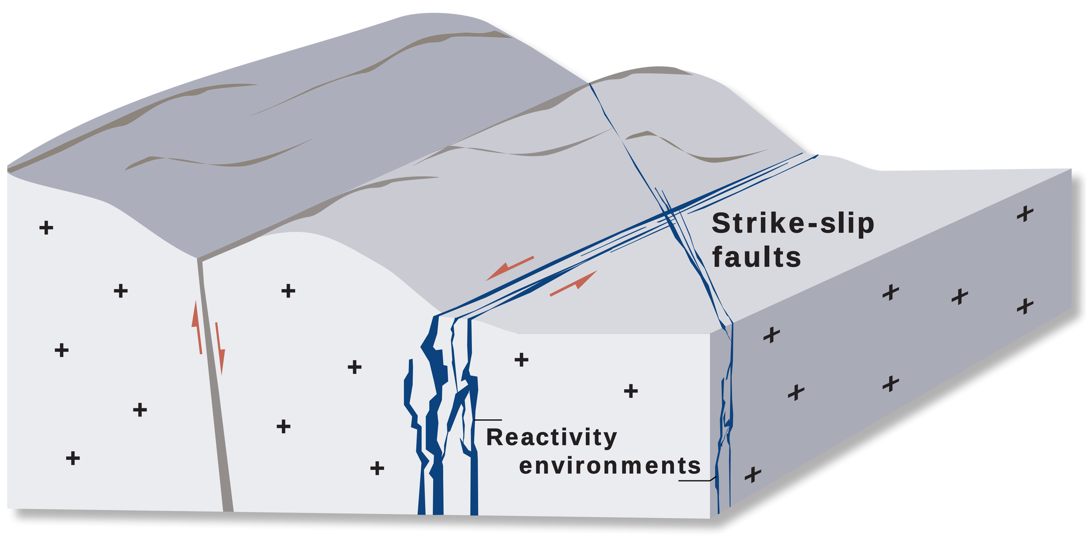
Origin of Life – tectonically controlled by Strike-Slip Faults of the Early Crust?

During formation of the earth crust more than 4.3 bn. years ago, probably first silica rich complexes, besides a basaltic crust, were formed. These silica rich complexes contributed to the formation of first continental cores. The increased temperatures of the earth mantle might have led to intensified convection currents. The primordial crust was put under intensified stress by these currents which led to the assumption, that extensive strike-slip faults were formed from the very beginning. These deep reaching faults penetrate the entire crust and are permeable to fluids and gas.

Together with the chemical compounds of the first crust and compounds from the earth mantle ideal conditions for the formation of first pre-biotic molecules were generated.

In the upper crust the conditions of the Fischer-Tropsch-synthesis (with temperatures between 160 and 200 °C) and variable pressure conditions were given to rise alkanes, alkenes and alcohols.

It is assumed, that the variation range of the reactivity environments connected to the fault systems was crucial. These reactivity environments had dimensions from nano to centimeter cavities and were interconnected over hundreds of kilometers. The entire volume of all environments was more than 10 km^3.



▲ *Detail of an early granitic crust*

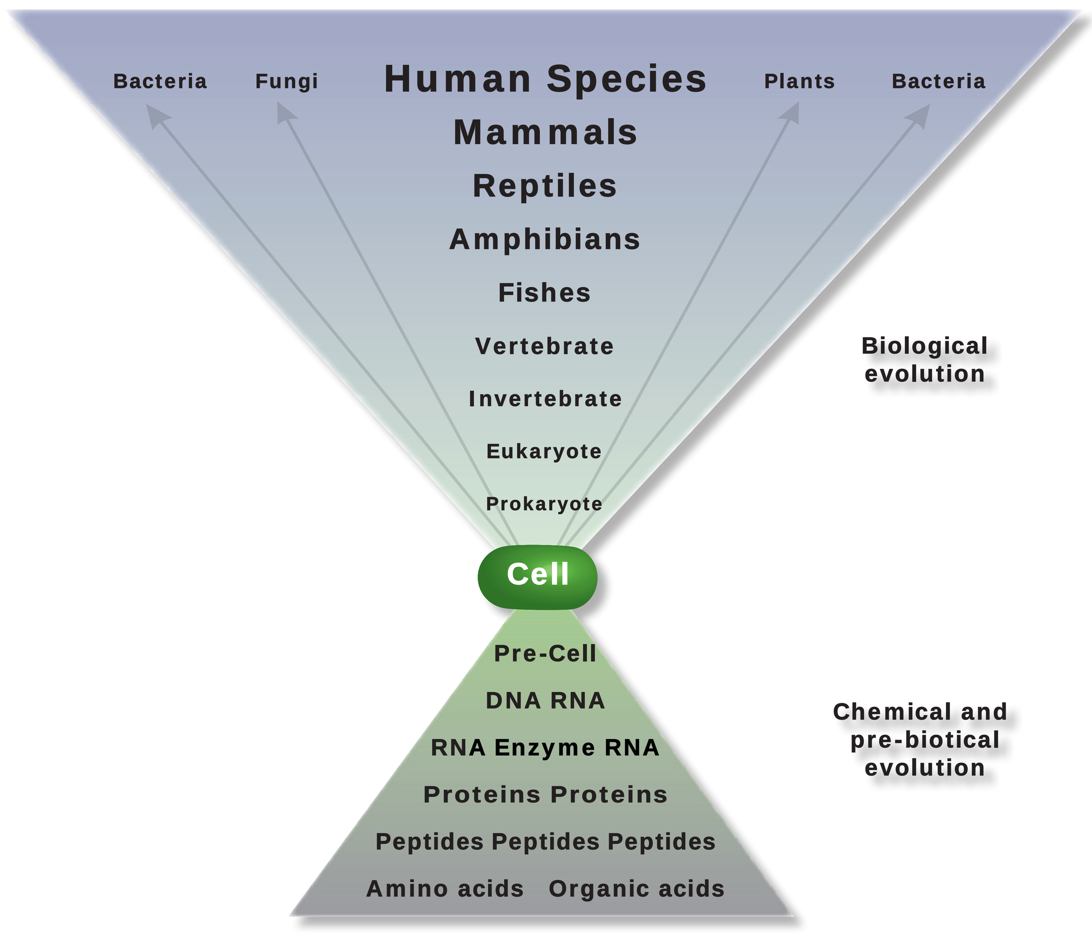
The overall advantage of this model is to provide a great but enclosed starting volume over a long time period. This starting volume underwent variable physico-chemical conditions which allowed to initiate a chemical evolution. From this starting volume a selection took place which led to long-chain compounds.

Those compounds found their "ecological niche" where they had been stable over a longer period. The connectivity via ramified fault systems ensured an exchange with and/or a contact to other compounds.

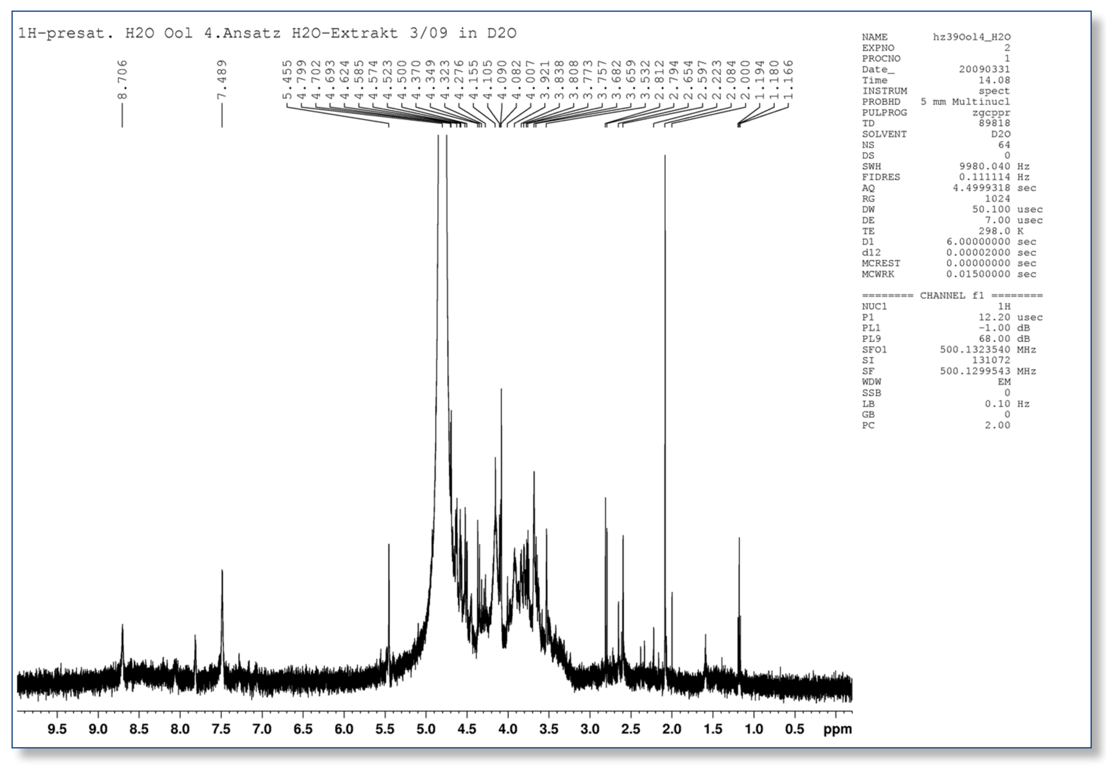
Advantages of the Strike-Slip Fault Theory	
Basic conditions	
Starting material	plentiful
p/T-conditions	highly variable
Catalysators	plentiful
Dimensions of reactivity environments	nano up to centimeter
Concentrations of compounds	variable (from high to low concentrations)
Energy	high: chemical energy, electricity
Surfaces	mineral surfaces, metallic surfaces, endlessly high
Entropy	opening of cavities*
Molecule transport	from hot to cold under decreasing pressure; accretion via collection of molecules

Fault systems	
UV-radiation	not existent, only after contact with atmosphere
Nuclear radiation	existent from very high to low levels (selection)
Impacts of meteorites	only local areas
Snowball effect	no effect
Selection processes	
Variation of physico-chemical conditions/ requirements	global
Radioactivity	local
UV-radiation	after transfer to surface water
Concentrations of salt	transfer of fresh water/ salt water on earth's surface

*Local pressure drops allow for expansion processes connected to an increase of the system entropy while complicated molecules are being formed (2nd law of thermodynamics)



▲ *Triangles of Life*

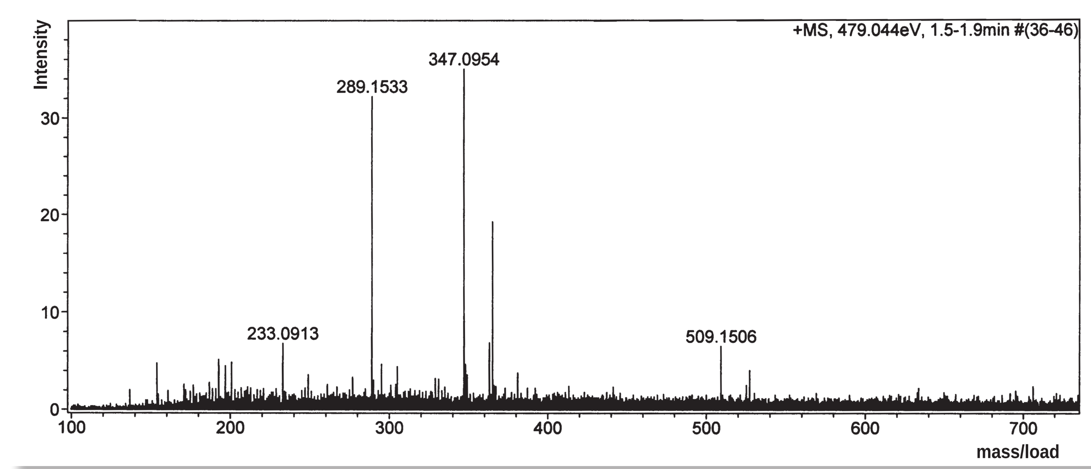


▲ *Proton NMR spectrum of the result of an experiment simulating the chemical processes in deep reaching faults. The resonances between 3.0 and 4.5 ppm derive from organic molecules rich in hetero atoms such as N and O.*

First experimental Results

The physical and chemical conditions within the faults have been simulated in a reaction container filled with various minerals (as potential catalytic surfaces) and the inorganic compounds expected to be present in volcanic gases. After the experiment, the resulting mixture was extracted with water. The extract was analyzed for water soluble organic components. The proton NMR spectrum of the aqueous extract shows the presence of a significant amount of proton signals between 3.0 and 4.5 ppm. These signals indicate the presence of organic residues such as R-OH, -OCH$_3$, -CHOH, -CH- and other groups which occur in organic compounds rich in hetero atoms such as nitrogen and oxygen.

A corresponding mass-spectroscopic analysis (ESI-TOF) of the same material exhibits the presence of numerous molecules of relatively large molecular mass. The most relevant contributions are represented by molecules with molar masses of 233 g/mol, 289 g/mol and 347 g/mol. The presumed sum formulas are $C_{10}H_{11}N_5O_2$, $C_{14}H_{19}N_5O_2$ and $C_{11}H_{11}N_{10}O_4$. The chemical structures of these products are presently being analyzed.



▲ *ESI-TOF mass spectroscopic analysis of the result of an experiment simulating the chemical processes in deep reaching faults. The peaks at 233 g/mol, 289 g/mol and 347 g/mol represent the characteristic reaction products which are formed during the experiment. Possible sum formulas corresponding to these peaks are $C_{10}H_{11}N_5O_2$, $C_{14}H_{19}N_5O_2$ and $C_{11}H_{11}N_{10}O_4$.*

Campus Essen / Campus Duisburg
U. Schreiber (Faculty of Biology and Geography)
V. Buck (Faculty of Physics)
M. Epple, H.-C. Flemming, Chr. Mayer (all Dep. of Chemistry)
O. Locker-Gruetjen (Science Support Centre)
Universitätsstraße 5, 45141 Essen
Forsthausweg 2, 47057 Duisburg
Tel.: +49 201 183-3100
eMail: ulrich.schreiber@uni-due.de
volker.buck@uni-due.de
matthias.epple@uni-due.de
hc.flemming@uni-due.de
christian.mayer@uni-due.de
o.locker-gruetjen@uni-due.de