nubian units along the westward dipping Moldanubian thrust and the Ramzová thrust.
Single- and multi-grain $^{40}Ar/^{39}Ar$-ages of detrital white mica from pre-, syn-, and postorogenic sandstones of the Variscan Moravo-Silesian Zone (MSZ) at the easternmost margin of the Bohemian Massif display a wide range of age groups from Precambrian to late Viséan.
Early to middle Devonian Old Red sandstones indicate a source area having a uniform Precambrian to early Cambrian age population (545-520 Ma) significantly younger than well-known zircon U-Pb ages (590-570 Ma) from the supposed Moravian source area. Viséan greywackes from the Moravo-Silesian Culm (syn-orogenic flysch) basin display similar age patterns in both the Drahany and the Jeseniky sub-basin. Early greywackes show a very heterogenous and mainly old age spectrum (347 Ma, 370 Ma, 430-450 Ma, 460-480 Ma, 515-520 Ma, 540-565 Ma, and 590 Ma). $^{40}Ar/^{39}Ar$ ages in younger greywackes indicate the input of young mica from newly exhumed metamorphic units. These late Variscan ages (340-320 Ma) are well-known from metamorphic and magmatic rocks in the westerly adjacent Moravian and Moldanubian zone in the hinterland (FRANK & SCHARBERT 1993, DALLMEYER et al. 1992, FRITZ et al. 1996, FRIEDL 1997). These relations constrain the uplift and exhumation of the rising mountain belt in the Moldanubian source area. First estimations show minimum exhumation rates (MER) of some km/Ma for micas found in both subbasins in the middle Viséan. In the upper Viséan MER decreases to 1/10 of the former value (< 1km/Ma). Both Ar/Ar age groups of detrital mica and exhumation rates point out the mutual origin of the Jeseniky Mountains and the Drahany Uplands as one N-S trending sedimentary basin (see also HARTLEY & OTAVA 2000).
Postorogenic sandstones from the Boskovice trough mainly bear late Variscan detrital mica (350-310 Ma). In the Permo-Carboniferous sediments two different age patterns were detected: in the western part Upper Carboniferous sediments shows 350-310 Ma ages. This suggest a continuation of the Culm-sedimentation through time and the exhumation of younger tectono-stratigraphic units in the western hinterland. In eastern parts early Permian sediments with 345-325 Ma ages occur, similar to detrial mica ages in the Upper Viséan Culm. These rocks are resediments of sandstones accumulated in Visán time above the Brno Massif, and were deposited in the eastern part of the Boskovice trough during the Lower Permian.

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Sedimentology and the Energy Industry

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Almost 90 percent of the primary energy supply to the economies of the world comes from oil (39 %), gas (24 %) and coal (27 %). The exploration for and the production of oil, gas and coal requires an accurate understanding of sediments. After all, the organic matter that is the source of oil, gas and coal is part of sediments, it matures in sediments; oil and gas migrate through sedimentary rocks, are trapped in sediments and are extracted by man from sediments. Knowledge of the three dimensional distributions of lithology, mineralogy, fossils, porosity, permeability, thermal maturity and pore fill and the comprehension of how these special distributions change over geologic time is of essence to the energy industry.
It is not surprising then that the energy industry plays an important role in the development and progress of sedimentology. The industry assembled an enormous data base on sedimentary rocks from field studies, millions of wells and millions of kilometres of seismic lines and has the computer capabilities to handle, process and display these data in 3D and 4D.

The past saw mutually beneficial collaboration between industry and academia in describing and classifying sedimentary rocks and their pore content, in deducing the physical and chemical processes that govern deposition and diagenesis of sediments, and in characterising and predicting sedimentary environments and their spacial settings. The results of this collaboration are truly fascinating and stretch from highly accurate and fast laboratory methods, over predictive modelling of sediment distributions and hydrocarbon migration pathways in basins through geologic time, to sequence stratigraphy.
Today progress in sedimentology comes increasingly from multidisciplinary teams that bring together sedimentologists, palaeontologists, petrophysicists and seismologists. The daily relentless effort in industry to link the seismic properties of sediments (such as p- and s- wave velocity, density, amplitude, coherency, frequency and phase) to the rock properties of sediments (such as mineralogy, lithology, environment of deposition, porosity, pore fill, pressure and permeability) and back to the seismic properties in thousands of iterations (inverse and forward modelling) is paying off. Some universities are part of these exciting developments, we wish more would join. The University of Leoben contributed important data on clay anisotropy.
We are now able to illuminate the subsurface in ways unthought of only a few years ago. Based on interdisciplinary team efforts we can not only accurately map subsurface structures like anticlines, normal and reverse faults below salt domes and salt overhangs, in three dimensions we also are able to map sedimentary bodies and their pore contents (oil, gas or water) with great accuracy. This gives industry the confidence to drill extremely expensive wells (costing $50 million plus each) in more than 1500 m of water aiming, for instance, for a gas bearing turbidite channel which is located underneath a salt overhang more than 7000 m below the seabed. Sedimentologists can be proud of their part in making this possible.
Oil, gas and coal have become commodities in the world markets. To ensure the future vitality of the energy industry ways will need to be found to keep finding cost, development costs and production costs as low as possible while oil and gas operations expand into high cost areas such as deep water. In the future the energy industry will need to accurately predict subsurface lithofaces variations, thermal maturity, pore content and fluid flow in 3D and 4D with resolutions of less than 10 metres at a depth of more than 10 kilometres. The linkage of sedimentology with 3D multicomponent seismic (3D/4C) appears very promissing for the future, We will need age datings with an accuracy of better than 10,000 years in sediments more than 500 million years old. High resolution and high accuracy would be wasted in sedimentology and elsewhere if we would not also develop our capabilities for 3D visualization. Today's immersive visualization systems are just a beginning. Soon multidisciplinary teams of scientists and engineers will be jointly diving and climbing through the 3 dimensional virtual reality of sediment bodies and their pore spaces seeing every minute detail. The future of the oil, gas and coal industry ultimately depends on

the prize humankind is willing to pay for power, light and mobility in terms of greenhouse gas emissions and climate change. Sedimentology will have a major role to play in understanding climate changes of the past in order to predict what is in store for us all in the future.

Sedimentgesteine – ein faszinierender Gegenstand der Petrophysik / Sedimentary rocks – a fascinating subject of petrophysics

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Sedimentary rocks are of high interest in geoscience and connected disciplines (reservoir engineering, soil and rock mechanics, material science).

Sedimentology today offers a broad spectrum of methods in order to characterise sedimentary rocks with respect to the mineral composition, structure and texture, depositional environment, and origin.

Forced by the oil industry geophysical methods have been developed for the reservoir exploration and characterisation. The measurement of electrical properties, seismic wave velocities, nuclear rock properties etc. logically implies the question "is it possible to characterise porous sedimentary rocks using such measured physical parameters, and derive porosities, saturation, clay content etc. from geophysical measurements ?" This question since years drives the development of the special disciplines "petrophysics, rock physics".

In 1942 ARCHIE published his fundamental equation about the relationship between the specific electrical resistivity of a water saturated porous rock (R_0), the specific resistivity of the formation water (R_w) and the porosity Φ

$$R_0 = R_w \cdot F = R_w \cdot \frac{a}{\Phi^m}$$

the new property he called "formation resistivity factor". The two parameters must be derived empirically from measured data. This equation demonstrates a basic philosophy in petrophysics

- use a physical plausible model assumption or model,
- analyse experimental data,
- derive an empirical modified equation.

The empirical coefficients and parameters in petrophysics express the limitation of the particular equation for a particular material, or – in other words – the impossibility to include all the varieties of the rock features in one general equation.

Growing interest in petrophysics in the following decades and today results from:

- the increasing importance of reservoir rock characterisation
- the particular interest in reservoir fluids, their motion and distribution
- the dramatic development concerning „input data" by the modern equipment.

We must transform this data into equivalent information about the properties of interest.

Petrophysics is one key in the network of applied geosciences and related engineering disciplines - it must connect the various properties of rocks. In this way, petrophysics

- is *integrated* into the general techniques, strategies, algorithms, and the complete process of exploration, and simultaneously
- is an integrating part of this process, because rock physics couples and connects different disciplines.

Experimental investigations show a colourful picture of dependencies of any (measured) geophysical property upon different parameters and influences. Because natural rocks are heterogeneous materials, consisting of components with different properties, it is obvious that their effective properties depend upon rock composition (volumetric fractions) and properties of the components (minerals, pore content). In most cases, the dominating difference between the properties of the solid and fluid constituents creates a distinct correlation with porosity. But also internal geometry such as grain size and its distribution, grain shape, texture and structure and bonding properties (e.g. cementation) and interface effects are influential. In many cases, there is a significant correlation between internal structure and anisotropic behaviour. - Additionally, these properties are usually influenced by pressure and temperature.

Theories and models must consider:

- sedimentary rocks are in terms of physics heterogeneous and structured materials
- this material must be described by models of simplified structures (geometry).

The derivation of a theory begins with a conceptual rock model. This model is the basis for the mathematical formulation of relationships between the different properties and parameters. On this way we expect

- a formulation of essential correlations, which are known from experiments,
- the calculation of properties without direct experimental determination,
- relations between physical and petrographic properties as a contribution to the integration process in geosciences.

The spectrum of model concepts in rock physics is very broad and extends from solid state physics (relevant to the earth interior) to suspensions (relevant to highly porous marine sediments). Despite this diversity, we can distinguish four „basic types" of models:

1. The model consists of parallel elements: Each element represents one component of the rock (mineral, pore content) with its specific properties and volume fraction
2. The model consists of an arrangement of solid particles or pores of a simple geometric form (e.g. spheres, ellipsoids, tubes, channels, spherical or ellipsoid inclusions)
3. Models based on special types or conditions of coupling and interaction of the two (or more) constituents of "the composite rock.
4. A structured model which consists of an oriented rock model in order to explain tensorial properties connected with internal geometry (anisotropy, structure influence, etc.).

Tendencies in petrophysics of sedimentary rocks are characterised by more general models in connection with focused experimental techniques directed on two main problems

- implementation of structural and textural rock properties
- study of the effects of fluid distribution in the pore space and effects of capillary pressure and interface phenomena.

Some applications and possibilities of the structural model are discussed with respect to the influence of porosity, „grain shape", structure and bonding properties on seismic velocities.

The investigation of pore space and fluid distribution can apply sophisticated Nuclear Magnetic Resonance techniques (NMR). The NMR spin-echo signal is a measure of the volume of the different types of formation fluids. Movable fluids in the pore space make up the slower decaying portion of the spin-echo while the capillary bound fluid produces the faster decaying portion.

Using this techniques some of the key-problems in sedimentary petrophysics can be studied in order to enrich our knowledge about sedimentary rocks.