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Dating of diagenetic reactions in Rotliegend sandstones

V. Havenith (1), S. Sindern (1), A. Gerdes (2), K. Wemmer (3), F.M. Meyer (1), and A. Hellmann (1)

(1) RWTH Aachen University, Institute of Mineralogy and Economic Geology, Fachgruppe Geowissenschaften und Geographie, Aachen, Wüllnertsrasse 2, Germany (sindern@rwth-aachen.de), (2) Institute of Geosciences, Johann Wolfgang Goethe University, Altenhöferallee 1, 60438 Frankfurt a.M., Germany, (3) Geowissenschaftliches Zentrum Göttingen, Georg-August-Universität Göttingen, Goldschmidtstraße 3, 37077 Göttingen, Germany

Isotope dating is an important tool to define time constraints to a diagenetic history deduced from successions of authigenic cement phases. In this study the K-Ar- and U-Pb-systems are applied for dating of illite and anatase in upper Rotliegend II sandstones in NW-Germany. Anatase was formed after breakdown of detrital rutile and ilmenite under oxidizing conditions following first illite growth and migration of hydrocarbons. It has euhedral to subhedral crystals, which occur as clusters of several grains within the pore space. Anatase is locally associated with hematite and/or carbonates reflecting simultaneous growth. An amount of 65 individual anatase crystals were analyzed in thin sections by LA-ICP-SFMS (Johann Wolfgang Goethe University, Frankfurt) in well characterized pore areas. The U content of these crystals ranges from 1 to 50 ppm. The U-Pb isotope data plot in an array in a Tera-Wasserburg diagram showing the contribution of common Pb. The data define a lower intersect with the concordia indicative of diagenetic anatase crystallization at 224 $\pm$ 6 Ma (Ladinian/Carnian). In addition, 10 detrital rutile grains were analyzed. After correction of common Pb, their data cluster around 327 $\pm$ 23 Ma, which is in line with the occurrence of upper Carboniferous volcanic rocks in the source area of detrital components.
Illite occurs as fibres and platelets within the pore spaces and was dated using the K-Ar-system at Georg-August-University, Göttingen. Data of 11 fractions differing in size and illite type range between 180 to 190 Ma and overlap within the limits of analytical uncertainty. Illite crystallinity values of most fractions show that the rocks were affected by late diagenetic to anchizonal conditions, which is not in accordance with maximum burial depth. It is inferred that hydrothermal fluid flux in Jurassic times caused temperatures exceeding 200°C. During this event new illite precipitated and older illite, in part formed prior to anatase in Triassic times, was reset. The U-Pb-system of anatase remained undisturbed and thus allows to date an early step in the evolution of cements in these rocks.