

NEW RESULTS FROM CONTINUOUS GASOMETRIC DETERMINATIONS OF CARBONATE IN CUTTINGS AND CORES FROM DRILL HOLES

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ABSTRACT

Continuous gasometric determination of carbonate in cuttings has been successfully used by the Mobil Oil AG in the Weser-Ems area since 1954. It is used to check changes in rock composition (facies development) during drilling and to compare the results with those of adjacent drillings.

Cuttings are taken at intervals of 1 to 2 m at the site of drilling; they are washed, dried, and ground. The amount of CO_2 is determined with the "Scheibler-Gasometer" (described in Müller, 1967) by treating 1/2 gr of the sample with HCl.

Absolute carbonate content and the approximate calcite/dolomite ratio can be estimated if the first reading is taken after 30 seconds, the second after 1 minute (sometimes after 5 minutes) and the final reading after the gas development is completed (to 21 minutes). The resulting "carbonate-log" can be compared with those of adjacent drill holes during drilling operation. Such logs are very useful for exploring carbonate reservoirs and for stratigraphic correlation of sections strongly influenced by tectonics and of rocks lacking fossils.

The Lastrup laboratory of Mobil Oil in Germany has checked about 80,000 samples in the last 17 years for total carbonate content and for the approximate calcite-dolomite ratio. These determinations are made with the Scheibler gasometer. Small (0,5 g) cuttings, samples or core pieces are treated with 1 : 1 hydrochloric acid. The evolved CO_2 displaces in a manometer an amount of water which indicates carbonate content. Continuous determinations taken by small intervals give a plotted carbonate log, which is a quantity diagram. The total reaction periods are used for a second plot; in addition, half minute, one minute of 5 minute logs are useful for showing the calcite-dolomite ratio. Experience shows that caving and slump material contamination in well cuttings is lessened by using the finer cuttings. The sieves used have 0.1 mm and 1.0 mm meshes. Fig. 1-3.

The first determinations were made in limestone and dolomite sequences of the Upper Malm sediments to determine facies developments where late diagenetic changes, especially secondary dolomitization, are very important for

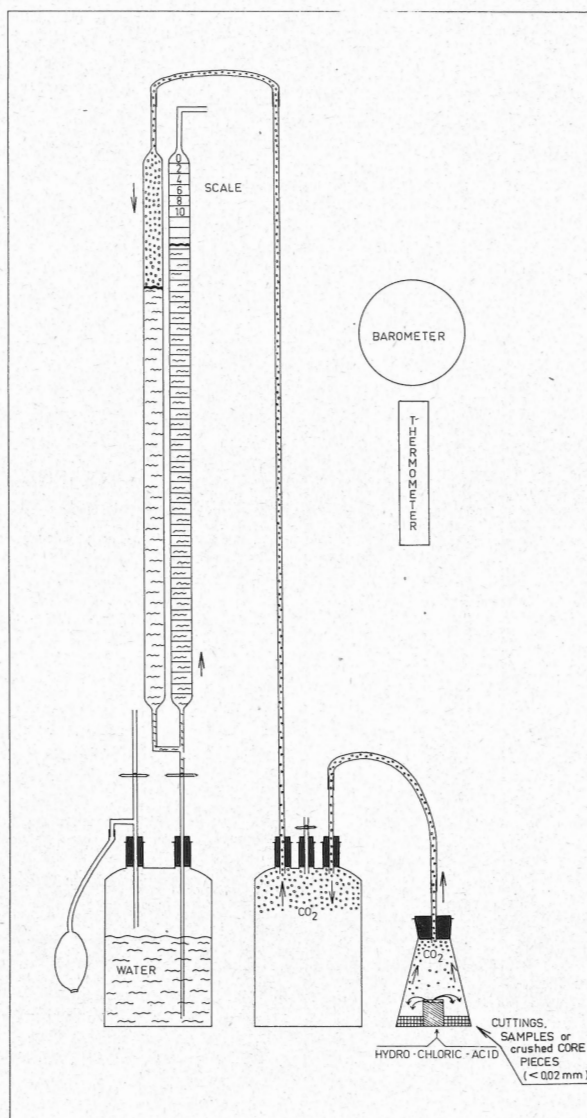


Fig. 1
Scheibler gasometer

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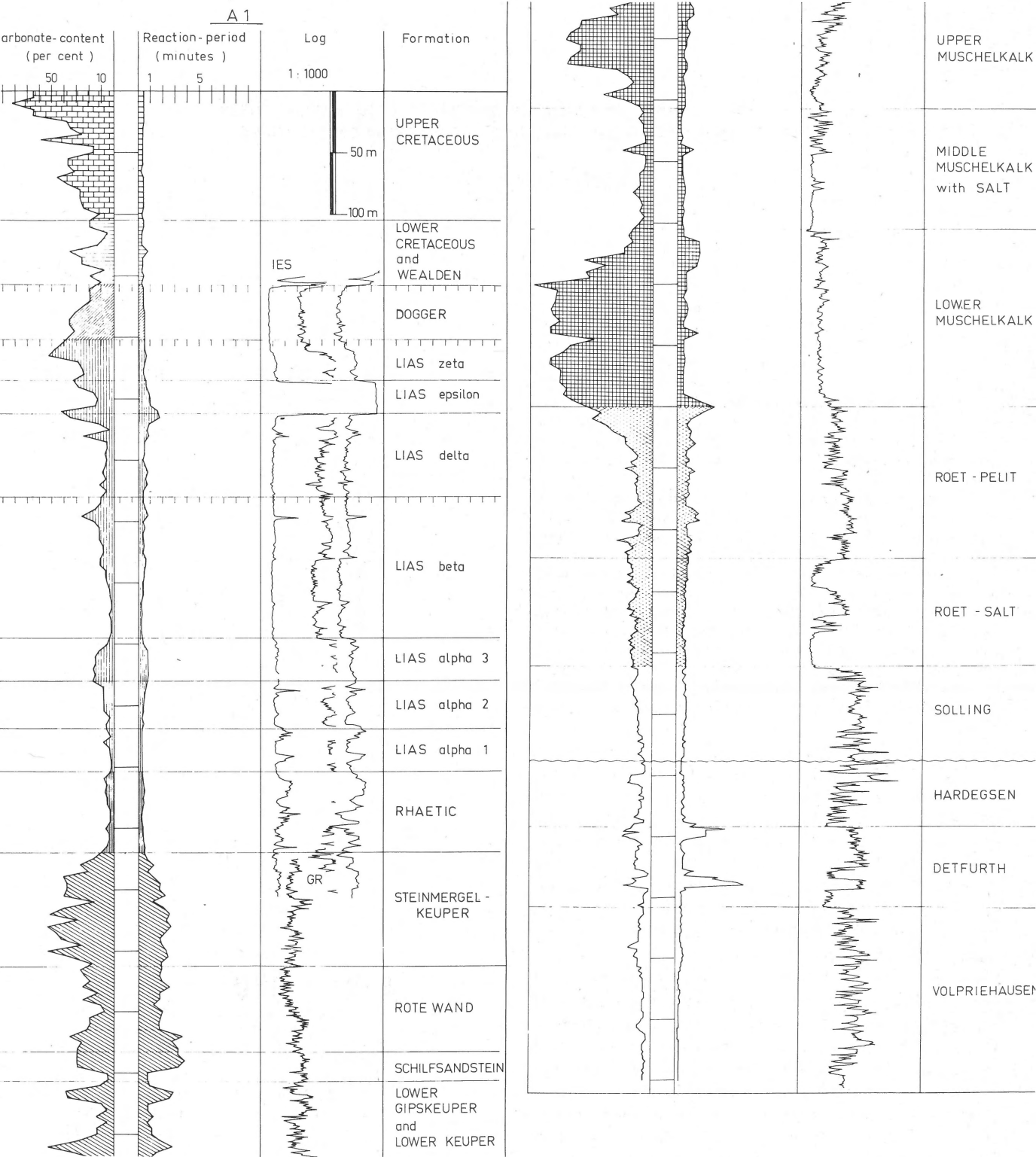


Fig. 2
Carbonate content log and reaction period log of an exploitation well.

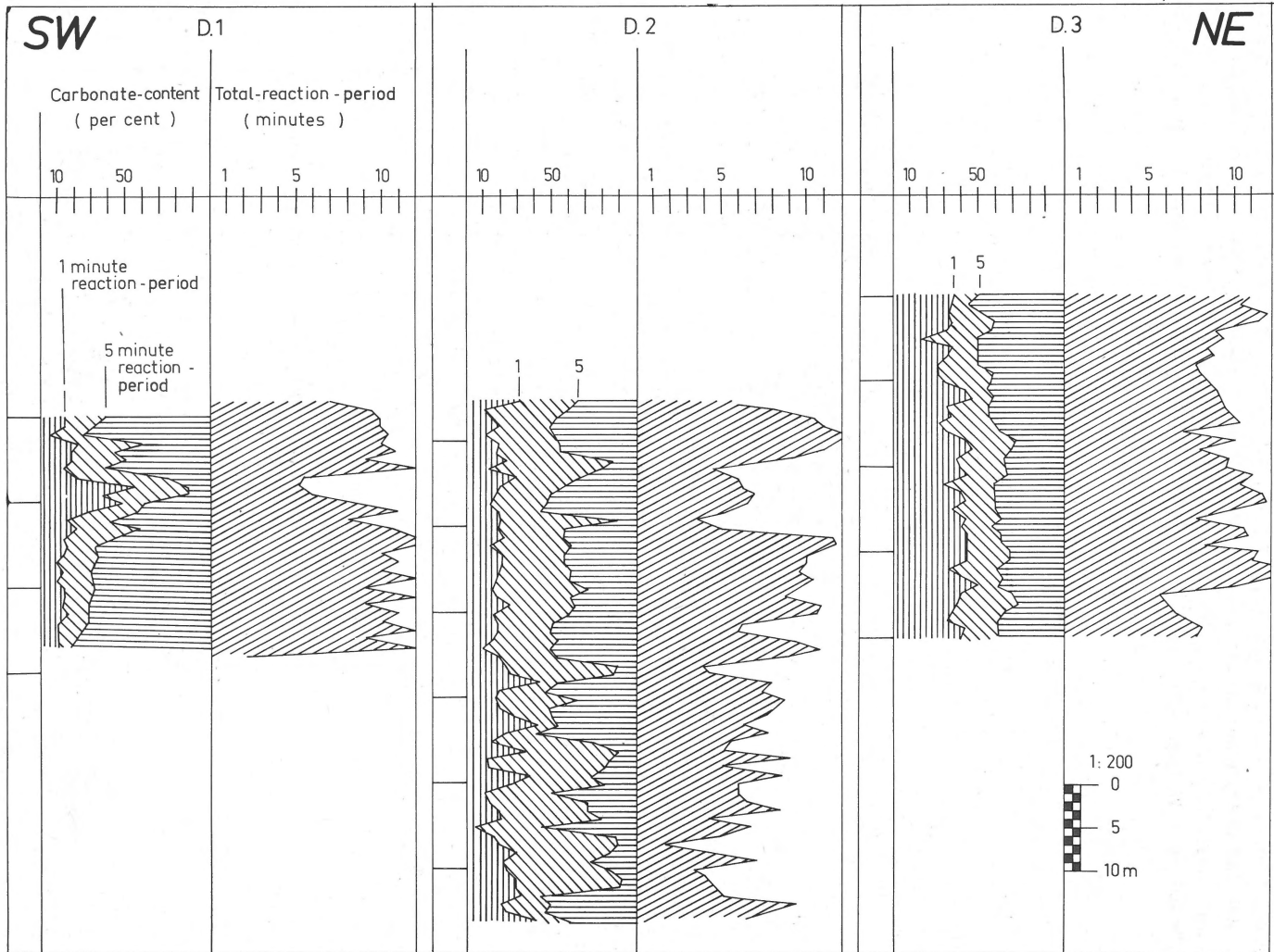


Fig. 3
Zechstein Main Dolomite. One minute, 5 minute and total reaction period logs (showing the facies development in the same stratigraphic unit).

accumulations of oil and gas. Later we made measurements in all calcareous formations. These logs were useful in the correlation of Permian and Carboniferous carbonates, particularly in wells that could not be logged for technical reasons, in non-fossiliferous formations, and in areas of strong tectonics. Some examples are given. In addition to their usefulness for correlations, these logs show facies developments, and show such features as faults and stratigraphical breaks. They also show sedimentary and diagenetic developments, as limestone and dolomite alternations over large areas probably

have a primary diagenetic origin. The success in correlation permits a stratigraphic interpretation in thick carbonate reservoir rocks as can be seen in two well sections in the Weser-Ems area. The short period logs show the regional development horizontally and vertically. Fig. 4-10.

In the Upper Carboniferous, in Stephanian and Westphalian high carbonate content facies crosses the clastic-pelitic facies and gives a better possibility for stratigraphic indications in non-fossiliferous sections. The persistence of the

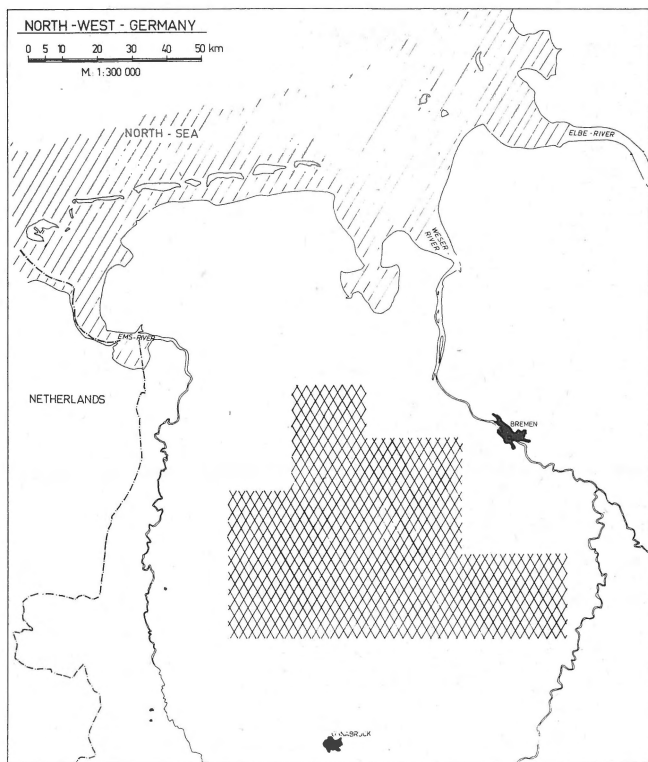


Fig. 4
Weser - Ems - Area showing example locations.

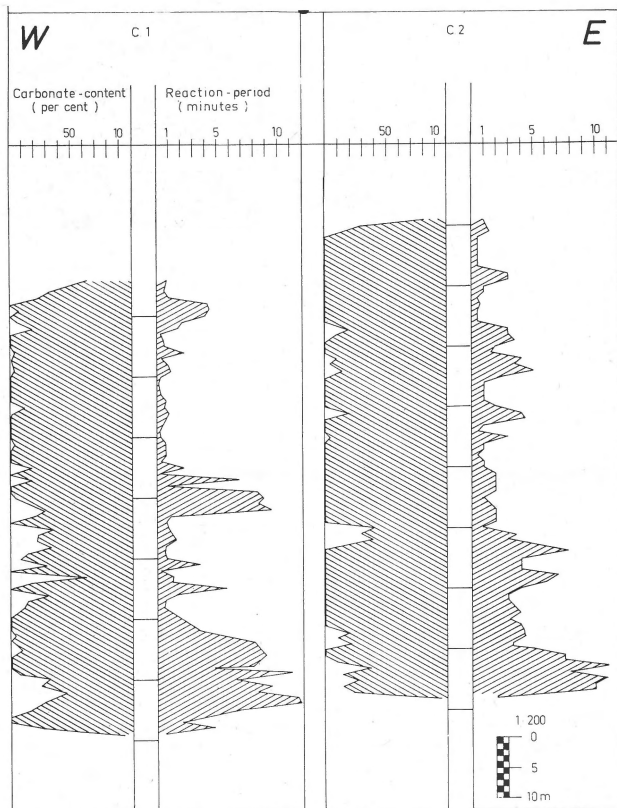


Fig. 6
Zechstein in Main Dolomite Carbonate content logs and reaction period logs.

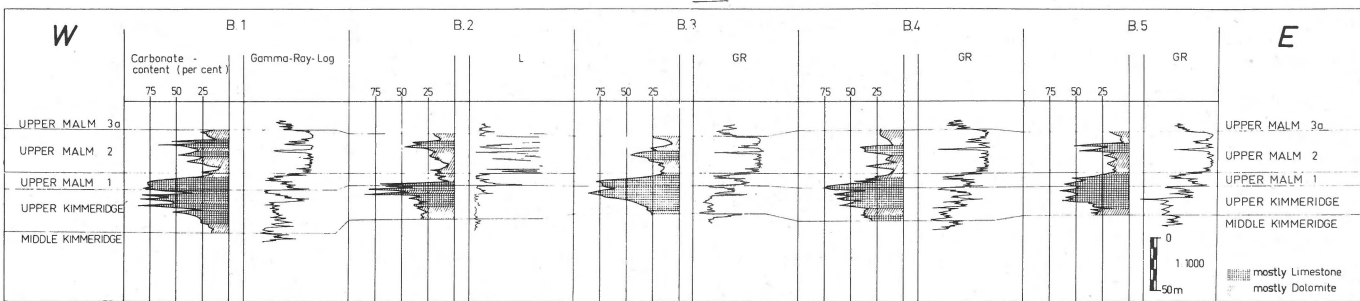


Fig. 5
Jurassic Upper Malm. Facies logs.

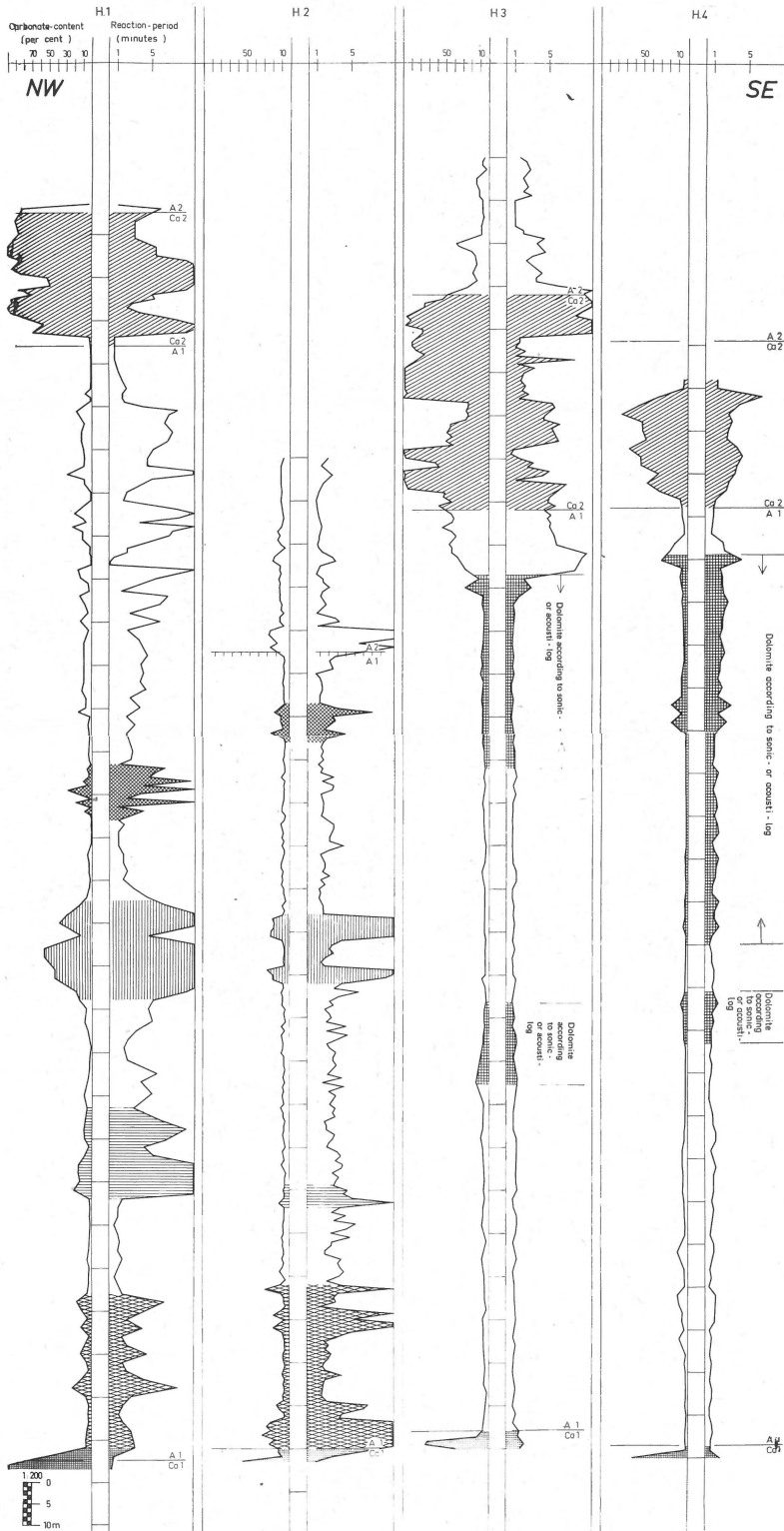


Fig. 7
Werra-formation. Carbonate content and reaction period logs.

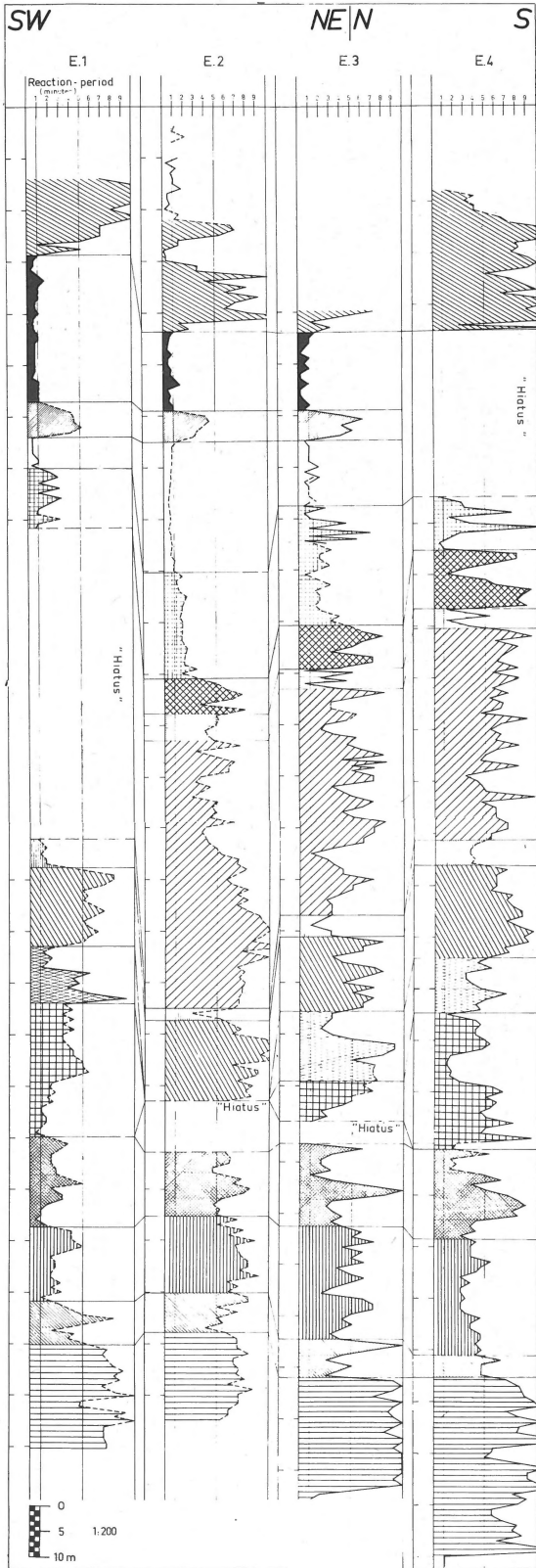


Fig. 8
Zechstein Main Dolomite Reaction periods logs (correlation in a local area.)

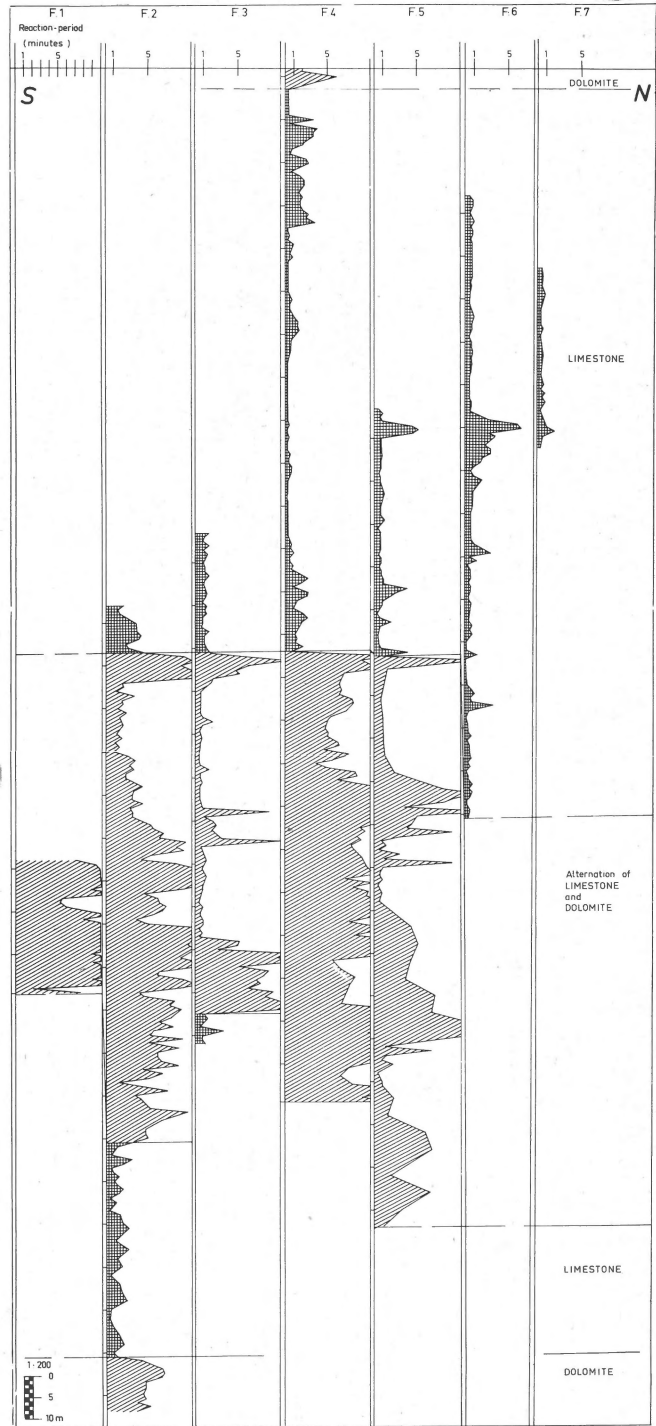


Fig. 9
Zechstein Main Dolomite. Reaction period logs correlation at a greater distance.

LITERATURE

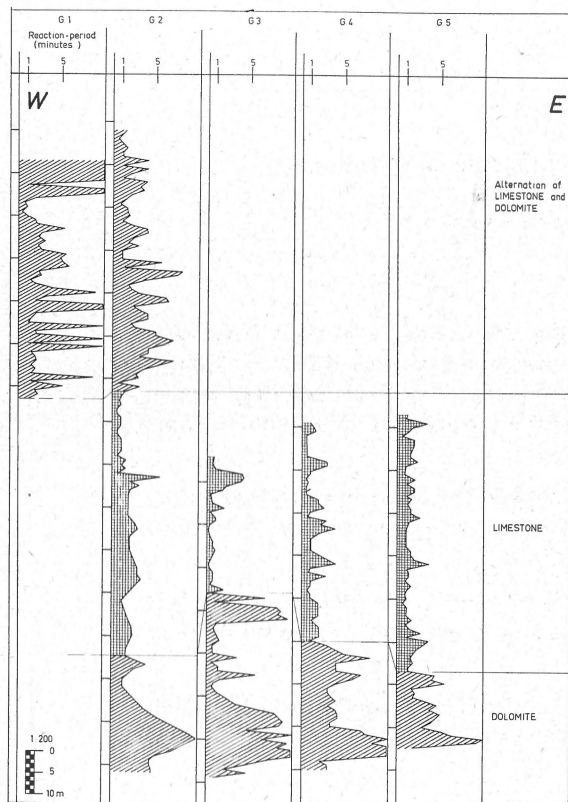


Fig. 10
Zechstein Main Dolomite Reaction periods logs correlation at a greater distance.

carbonate cycles makes them valuable as criteria in determining beds of the same age. Fig. 11.

This method is useful in drilling exploratory wells in the carbonate rocks, as subsurface maps can be made with lines referring to the cycles of carbonate enrichments. Cores and test zones can be located based on the results of these logs and facies developments (such as reefs) can be seen as the well is drilling. The total carbonate logs are important for well-acidization programs, and the reaction-time logs help in preparation of the sample logs and facies maps.

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- Brauner, J. & Buntfuss, J. (1966/67) – Sedimentologische Untersuchungen im Oberen Westfal C und Unteren Westfal D des Ibbenbürener Karbons. *Fortschr. Geol. Rheinld. u. Westf.* 13, 2, p. 1095-1108.
- Eckhard, F.J. & v. Gaertner, H.R. (1956) – Über Dolomite aus den Sedimenten des Ruhrkarbons. *Geol. Jb.* 71, p. 427-432.
- Esch, H. (1966/67) – Vergleichende Diagenese-Studien an Sandsteinen und Schiefertönen des Oberkarbon in Nordwestdeutschland und den East Midlands in England. *Fortschr. Geol. Rheinld. u. Westf.* 13, 2, p. 1013-1084.
- Füchtbauer, H. (1964) – Fazies, Porosität und Gasinhalt der Karbonatgesteine des norddeutschen Zechsteins. *Z. deutsch. Geol. Ges. Bd.* 114, p. 484-531.
- (1968) – Carbonate sedimentation and subsidence in the Zechstein Basin (Northern Germany) in: *Recent developments in carbonate sedimentology in Central Europe*, p. 196-204. Berlin-Heidelberg-New York 1968.
- Hecht, F., Hering, O., Knobloch J., Kubella, K. & Rühl, W. (1962) – Stratigraphie, Speichergesteins-Ausbildung und Kohlenwasserstoff-Führung im Rotliegenden und Karbon der Tiefbohrung Hoya Z 1. *Fortschr. Geol. Rheinld. u. Westf.* 3, 3, p. 1061-1074.
- Jessen, W. (1954) – Frühdiagenetische und spätere Veränderungen der Sedimente des Ruhrkarbons. *Geol. Jb.* 69, p. 195-206.
- Müller, G. (1953) – Chemische Zusammensetzung und Mineralbestand karbonatischer Schlechtenausfüllungen aus Steinkohlenflözen des Ruhrgebietes. *Bergbau-Rdsch.* 5, p. 6-8.
- (1967) – *Methods in Sedimentary Petrology*, 283 p. New York, Hafner Publishing Company. (1952) – Vorkommen und Entstehung der Karbonate, insbes. der Eisenkarbonate in den Steinkohlenflözen des Ruhrgebietes. 92 pp. Diss. Bonn.
- Rabitz, A. (1957) – Flözgleichstellung in den Essener Schichten nördlich Bochum und Dortmund. *Geol. Jb.* 73, p. 389-456, Hannover 1957.
- (1966/67) – Das Fehlen der Konglomeratischen Finefrau-Sandsteine (Westfal A) im nordwestlichen Ruhrrevier. *Fortschr. Geol. Rheinld. u. Westf.* 13, 2, p. 1085-1094.
- Scherp, A. (1963) – Die Petrographie der Paläozoischen Sandsteine in der Bohrung Münsterland 1 und ihre Diagenese in Abhängigkeit von der Teufe. *Fortschr. Geol. Rheinld. u. Westf.* 11, p. 251-282.
- Schettler, H. (1965) – Untersuchungsmethoden und stratigraphische Ergebnisse von Trias- und Zechsteinbohrungen im Weser-Emsgebiet. *Z. deutsch. geol. Ges.* 115, p. 214-227.
- (1968) – Continuous Gasometric Carbonate Determinations in Cuttings from Drill Holes, in: *Recent developments in carbonate sedimentology in Central Europe*, p. 254-255. Heidelberg, New York.
- Schuster, A. (1968) – Karbonstratigraphie nach Bohrlochsmessungen, *Erdöl-Erdgas-Zeitschrift* 12, p. 439-457.
- Stadler, G. (1963) – Petrographie und Diagenese der oberkarbonischen Tonsteine in der Bohrung Münsterland 1. *Fortschr. Geol. Rheinld. u. Westf.* 11, p. 283-292.
- (1963) – Die Mineralführung der Klüfte in der Bohrung Münsterland 1. *Fortschr. Geol. Rheinld. u. Westf.* 11, p. 293-304.
- Teichmüller, M. & Werner, H. (1953) – Ein echter Torfdolomit in einem Flöz der mittleren Bochumer Schichten und die Frage nach der Herkunft der Karbonate im Ruhrkarbon. *Geol. Jb.* 68, p. 141-154.
- Werner, H. (1955) – Über dolomitisches Bindemittel in den Sedimenten des Ruhrkarbons. *Geol. Jb.* 71, p. 423-426.