

The “Karbonat-Bombe”, a simple device for the
determination of the carbonate content in sediments, soils
and other materials

By German Müller and Manfred Gastner, Heidelberg

With 1 figure in the text

Abstract

A field method for the accurate determination of the carbonate content of sediments, soils, etc., is described using a new device, the "Karbonat-Bombe". Treatment of a sample with HCl in the closed instrument creates a CO₂ pressure proportional to the CaCO₃ content of the sample.

Introduction

A great number of sediments, soils or ores contain calcite and dolomite. Their qualitative proof may be easily conducted in the field by their reaction with hydrochloric acid. When the acid contains in addition Alizarin-Red-S as an indicator then calcite may be differentiated in coarse-grained materials from dolomite by its characteristic red stain.

A semi-quantitative determination of the carbonate content is not possible by the estimation of the degree of the gas development since too many factors (temperature, grain size, porosity and permeability, etc.) affect the result (MÜLLER 1967). In order to give the field geologist and prospector the possibility to precisely determine the carbonate content of his collected samples immediately, on site or in a field laboratory, a simple device was developed. With the help of this device the CO₂-content of a sample and the calculated value of the calcite concentration may be ascertained by the measurement of the CO₂-pressure after the treatment of a sample with

HCl. Under the designation "Karbonat-Bombe"*; this device was given to over 20 interested parties in the past few years by us, for which reason the name should be retained in the future.

Description of the instrument

The device, a total of 25 cm high (diameter 6 cm), and weighing 540 gm (Fig. 1), consists of the following separate pieces (Fig. 1 a—f):

- a) a manometer calibrated in % of CaCO_3
- b) a thumbscrew with gasket
- c) a threaded cap. A drilled hole in the cap may be opened or closed by the threaded thumbscrew (b)
- d) a gasket which fits between the cap and the cylinder (f)
- e) a 10 ml plastic container with an A-shaped handle for insertion
- f) a threaded plexiglass cylinder 15.5 cm high.

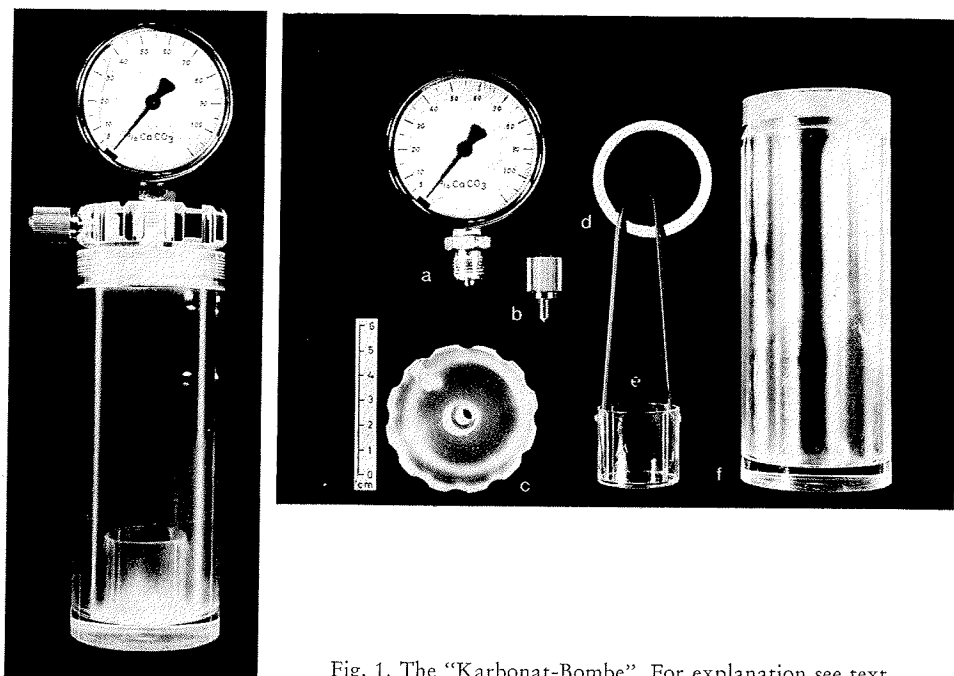


Fig. 1. The "Karbonat-Bombe". For explanation see text.

* The literal translation "carbonate bomb" has a different connotation than the one implied. In German, the term "Bombe" also has the meaning of a sealed container in which pressure is maintained or may be increased.

How to carry out the measurement

1 gram of dried and ground-up rock material is put into the cylinder (f). The plastic container (e) already filled with 5 ml concentrated HCl is inserted into the cylinder (f). This should be carefully done to insure that no acid is spilled on the rock material.

After this the gasket (d) is inserted and the cap (c) upon which the manometer (a) and thumbscrew (c) are mounted, is screwed down. If the thumbscrew is tightened, the pressure will increase when the cap is fastened down by the decrease in volume within the cylinder (movement of the manometer needle!). The opening and closing of the thumbscrew (c) allows for the equalization of the interior with the exterior pressure before proceeding. If the thumbscrew is open before the cap is tightened down then it must be closed afterwards.

By tipping the entire "Bombe" the acid in the plastic container comes in contact with the rock powder. A light shaking insures that all the rock powder comes in contact with the acid. Calcite and aragonite react immediately by effervescing strongly: After 10 seconds the reaction is already finished. The dolomite reaction sets in very slowly; after 10—15 minutes an apparent constant pressure is obtained. If calcite and dolomite are found together in the same rock a reading after 10 to 15 seconds yields the approximate calcite portion. A second reading after 15 minutes yields the total carbonate content. The approximate dolomite content is taken from the difference.

Calibration of the scale

Since the volume of a gas is dependent on the temperature and atmospheric pressure, the CaCO_3 -values read from the manometer must be corrected in every case. For this reason the true value of 100% CaCO_3 must be determined before the beginning of each series of measurements for the conditions in effect at that time. This is done with the help of a standard sample of 1 gm pure CaCO_3 (easily obtainable from any chemical supply house).

If the manometer shows for example 104% CaCO_3 for the standard sample, then each measured value is multiplied by a factor of $\frac{100}{104}$, in order to calculate the true value of CaCO_3 .

In general the following holds true:

$$\% \text{CaCO}_3 \text{ (unknown sample)} = \frac{\text{CaCO}_3 \text{ manometer value} \times 100}{\text{CaCO}_3 \text{ (manometer value of the standard sample)}}$$

Measurement accuracy

The absolute error of a single determination may be given as $\pm 1\%$ CaCO₃. With the weighing of 1 gram carbonate contents under 5% are not exactly measurable. When specifically small contents occur, then the weighing should be doubled or tripled.

Calculation of the dolomite portion

Dolomite develops more CO₂ than the same amount of calcite. A correction is — within the scope of a field study — not necessary since after 15—45 minutes of acid treatment approximately 5—8% dolomite will not have reacted (DREIMANIS 1962). A surplus of CO₂ will thus be eliminated for the most part by the dolomite portion which has not yet been dissolved.

Acknowledgements

The authors thank G. A. RAAB for his translation of the German version of the manuscript.

References

- DREIMANIS, A.: Quantitative gasometric determination of calcite and dolomite by using Chittick apparatus. — *J. Sediment. Petrol.* 32, 520—529 (1962).
MÜLLER, G.: *Methods in Sedimentary Petrology*. — 283 p. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, and Hafner Publishing Company, New York and London (1967).

Manuscript received by the editor August 23, 1971.

Authors' address:

Prof. Dr. G. MÜLLER and M. GASTNER, Laboratorium für Sedimentforschung,
Mineralogisch-Petrographisches Institut der Universität, 69 Heidelberg, Berliner
Straße 19.