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ON THE CONTINUITY OF THE SOLID SOLUTION SERIES SMITHSONITE-SIDERITE

A b s t r a c t. The results of electron microprobe studies of trigonal carbonates of the series ZnCO₃ (smithsonite) — FeCO₃ (siderite) from the Cracow—Silesian Zn and Pb ore deposits have lent support to the hypothesis of continuity of this isomorphous series.

INTRODUCTION

The continuity of the isomorphous series of anhydrous trigonal zinc and iron carbonates (smithsonite—siderite) has been a subject of much discussion. The earliest studies, based on chemical analyses of Fe-smithsonites (monheimites) and Zn-siderites, led to the conclusion that there was a miscibility gap in the solid solution series of these carbonates over a certain range of Zn:Fe ratios, on the side closer to siderite (Doelter 1912, Dana et al. 1951). The highest known iron content in monheimites corresponded to the atomic ratio of Zn:Fe = 0.7:1 (i.e., about 59 mol. % FeCO₃), while the zinc content in siderites was thought to be not greater than 2 wt. % ZnO. Some authors, however, postulated the continuity of the isomorphous series in question (Ferrari, Colla 1936; Strunz 1957).

Later on, when X-ray method was introduced to the studies of carbonates of the smithsonite—siderite series, it has been found that there exist members with the lattice constants that are intermediate relative to the respective values for pure smithsonite and siderite. Such investigations were made by Żabiński (1958) and Bąk and Nied (1979) for monheimites occurring in the Cracow—Silesian Zn—Pb ore deposits, and by Sitzia (1965) for monheimites from Montevecchio. Yet the continuity of this isomorphous series was still an open question because the cited authors did not find members showing any appreciable molecular prevalence of FeCO₃ over ZnCO₃. In 1977 Shikazono described siderites from

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Japanese deposits, in which chemical analyses showed a ZnCO₃ content running up to 8 wt.%

Recently, Bąk and Nieć found a new occurrence of monheimites and zinc siderites in the Bolesław mine near Olkus, in the Cracow-Silesian Zn and Pb ore deposits. Microprobe studies of these minerals, as well as analyses of the already known monheimites from Chrzanów (Matylda mine), have thrown light on the problem of continuity of the isomorphous series under study.

**MATERIALS AND METHODS**

A few monheimites and zinc siderite samples from the Bolesław mine were subjected to chemical analysis and X-ray investigations. The minerals in question form fine-grained, compact aggregates of grey colour, sometimes with a greenish tinge, or thin incrustations on the walls of cavities in dolomite (dolostone), or thin veinlets cross-cutting dolostone (Bąk, Nieć 1979, 1981).

Quantitative determinations of Zn and Pb contents in the samples were carried out with classical methods. A few microprobe analyses for Zn, Fe, Mn, Ca, Mg, Pb and S were made for each sample. Electron microprobe studies were also carried out on a few samples of monheimitic galmeis from Chrzanów. The latter minerals form compact, fine-grained grey or yellow-grey aggregates but, in contrast to the samples from Bolesław, they contain a substantial admixture of dolomite (Zabinski 1968). Because of this, the classical methods of analysis applied to these minerals do not allow one to make inferences as to the ZnCO₃ : FeCO₃ quantitative ratio. The analyses were carried out on an ARL SEMQ electron microprobe operated at an accelerating voltage of 20 kV. The samples were coated with carbon film. K, spectral lines were utilized for Fe, Zn, Mn, Ca, Mg and S determinations, using the following spectre standards: Fe, Zn, Mn, Mg, CaF₂, CaCO₃ and FeS₂. Lead was determined from the M line, using spectre PbS as standard.

The lattice constants a and c were determined for some samples. A powder pattern was taken for this purpose, using film technique. It was recorded with a TUR M-60 X-ray apparatus with a 114.6 mm camera, using filtered CoKα radiation. The film was cut asymmetrically by Stromanis-levins method. The distance between lines was measured with an accuracy of 0.05—0.1 mm. When calculating d_ab values, corrections were made for film shrinkage and X-ray absorption in the samples.

**RESULTS AND DISCUSSION**

Electron microprobe data obtained for the smithsonite-siderite series have thrown new light on the continuity of this isomorphous series, as they permitted a determination of the chemical composition of single mineral grains or small grain aggregates. Classical chemical analysis, on the other hand, as well as X-ray investigations, requiring the use of a greater amount of sample, were generally able to yield only averaged data.

The results of chemical and X-ray analyses of minerals of the smithsonite-siderite series are shown in figure 1. In the upper part of the

![Figure 1](image)

**Fig. 1.** Cell parameters and chemical composition of members of the isomorphous series smithsonite-siderite. After: Doelter (1922) and Dana et al. (1961) - small triangles, Sitzia (1965) - squares, Shikazono (1977) - S, present authors' data - full circles and dots. Other explanations in the text.
miterate and calcite, amounted to a few per cent. Control determinations of S gave negative results for all the microareas analysed. The contents of Mn and Pb did not exceed 1 wt.% in any microarea. When plotting these results in a grid, it was assumed that ZnCO₃ + FeCO₃ = 100%.

It is evident from fig. 1, that while the results obtained with classical methods testify to discontinuities both near the siderite end-member and in the smithsonite section of the series, the microprobe data point to the continuity of the smithsonite-siderite series. At any rate, the results of 32 microprobe analyses do not leave any discontinuity in the siderite section of this series, which discontinuity was mentioned by Dana et al. (1951).

The ascertainment of the continuity of the isomorphic series smithsonite-siderite also permits one to define rationally the nomenclature referring to its members. If the previously postulated miscibility gap existed in the siderite section of the solid solution series of these carbonates, then the name of monheimite would refer to the members that are between this discontinuity and smithsonite, and therefore also to ferrosmitsonites with a certain atomic prevalence of Fe over Zn, while on the other side of the discontinuity there would be a limited series of zinc siderites. In the light of the present investigations it becomes obvious that the name of ferrosmitsonite and zinc siderite should be used for the respective halves of the ZnCO₃—FeCO₃ series, showing an atomic prevalence of Zn or Fe. The traditional name monheimite (Kenné 1853, fide Dana et al. 1951), on the other hand, seems to be unnecessary.

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SHIKAZONO N., 1977: Composition of siderite and the environments of formation of vein-type deposits in Japan. Econ. Geol. 72.
Фиг. 1. Параметры решетки и химический состав энзимов изоморфного ряда смитсонит-сидерит
Данные: Deilfer (1912), Dana et al. (1951) — треугольники, Sitzia (1965) — квадраты. Shikazono (1977) — S, авторы этой работы — кружки и точки.
Другие объяснения в тексте

IRENA KARDYMOWICZ
1899—1980
UKD 92 Kardymowicz II: 548(549)+352:54(438)+ (056, 1899.05.29)1980.08.08

W dniu 8 sierpnia 1980 r. zmarła w Warszawie, emerytowana docent Instytutu Geologicznego, Irena ze Spryngowiczów Kardymowicz. Urodziła się 29 maja 1899 r. w Rzeczycy na Łotwie, jako córka Aleksandra i Marii. W rodzinnym mieście ukończyła szkołę średnią w 1920 r., po czym do 1922 r. była tamże nauczycielką w Polskiej Szkole Podstawowej. Za zaszczydzone pieniędze postanowiła podjąć studia chemiczne, które w 1922 r. rozpoczęła na Wydziale Matematyczno-Przyrodniczym Uniwersytetu Stefana Batorego w Wilnie. Pod wpływem prof. Józefa Łukaszewicza (wykładowcy krystalografii) oraz prof. Pawła Rydzyńskiego (wykładowcy petrografii i mineralogi) zainteresowała się naukami geologicznymi. Podczas studiów została 1 kwietnia 1926 r. asystentem przy Katedrze Mineralogi i Petrografii USB (funkcję tę pełniła do 15 grudnia 1939 r., tj. do...