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ORIGIN OF THE ORE-BEARING DOLOMITE IN THE TRIASSIC OF THE CRACOW-SILESIAN Pb-Zn ORE DISTRICT

(1 fig.)

O pochodzeniu dolomitu kruszconośnego w triasie śląsko-krakowskim

(1 fig.)

Abstract: The ore-bearing dolomite was formed by recrystallization of early-diagenetic dolostones and dolomitization of limestones. The magnesium ions required for dolomitization were chiefly derived from early-diagenetic dolostones existing in the structural environment in which the ore-bearing dolomite was produced. The formation of the ore-bearing dolomite is thought to have been effected by a combined action of hydrothermal solutions and mobilized ground waters. The hydrothermal solutions rose on a broad front along the north-eastern margins of the Silesian Basin and spread to the south and south-west guided by sedimentary interfaces and porous primary dolostones.

The present paper aims to reconstruct the structural environment of processes that have led to the formation of the ore-bearing dolomite in the Triassic of the Cracow-Silesian region. The following discussion is meant as a supplement to an earlier publication by Bogacz et al. (1972).

Our discussion can best begin with a few statements concerning the Triassic of the area. The Triassic consists here of a tri-component sequence; the Bunter sandstones and carbonates, the Muschelkalk carbonates and the Keuper clays (Fig. 1) (for details and references see Assmann, 1944, Siedlecki, 1949). Two unconformities of regional extent which mark the lower and upper limits of the Triassic sequence, separate it from the underlying Precambrian and Paleozoic rocks and from the overlying Liassic sediments. In addition to minor hiatuses, indicative of failure of deposition or submarine erosion, the continuity of the Triassic deposits is interrupted by two slight unconformities of local extent one between the Muschelkalk and Keuper and the other between the Keuper and Rhaetian (see Tokarski, 1965; Moryc, 1971; Grodzicka-Szymanko and Orłowska-Zwolińska, 1972).

The Triassic sediments rest with a marked transgressive overlap upon eroded surface of Precambrian and Paleozoic rocks. An outstanding feature of this surface is a structural and topographic elevation indicated as the „Kraków—Myszków Silurian Zone" (Siedlecki, 1962) or „Myszków—Kraków—Rzeszotary—Tymbark anticlinal elevation" (Konior, 1966). The elevation delineates the north-eastern and eastern boundary of the Silesian Basin. It is comprised of Precambrian, Lower and Middle Paleozoic sedimentary rocks (see e. g. Siedlecki, 1962; Roszek and Siedlecki, 1963; Ekiert, 1971, 1971 a; Łydka, 1973; Rulski, 1974; Bukowy, 1964, 1964 a, 1972).

The Cracow—Myszków elevation has been conditioned by late Paleozoic tectonic movements and has been cut by numerous igneous rocks related to Paleozoic plutonic activity. At least in the area of Siewierz, the southern edge of the elevation may have its origin in the deep lineament indicated by gravity anomaly (Rulski, 1974).

Already at the close of Paleozoic time, the Cracow—Myszków elevation ended toward the south-west along an escarpement which faced the low-relief Silesian Basin. After a prolongued period of erosion that followed the late Paleozoic uplift, the topography of the elevation was reduced. However, the more resistant rocks still projected as lofty knobs up to 200 m. above the adjacent lowlands (Alexandrowicz, 1971; Wyczółkowski 1971). These lowlands became submerged under the sea level at the close of Bunter time. However, through all lower and much of middle Muschelkalk time, considerable parts of the elevation stood out above the sea level. The previously mentioned knobs formed small islands (see Alexandrowicz and Siedlecki, 1960; Śliwiński, 1969), and it was not untill the end of middle Muschelkalk time or later, that these islands became submerged [1].

The emergent parts of the Cracow—Myszków elevation formed a barrier that divided the Muschelkalk sea in Southern Poland into two basins; the Silesian Basin on the west, and the Miechów—Sandomierz Basin on the east side of the barrier (Fig. 1 A, compare also Senkowiczowa, 1961).

The Cracow—Myszków elevation is closely related to localization of the ore-bearing dolomite and the ores. The ore-bearing dolomite tend to occur on the west side of the previously mentioned barrier. Nothing comparable to it has been found on the east side and further away from the Cracow—Myszków elevation.

Typically, the ore-bearing dolomite is a neosome recrystallized to sugary texture with obliteration of micrite and microfossils. It tends to occur in form of stratabound (not stratiform!) bodies.

[1] The dating of this event is not certain because the emergent areas were planned off prior to and during the Middle Jurassic transgression.

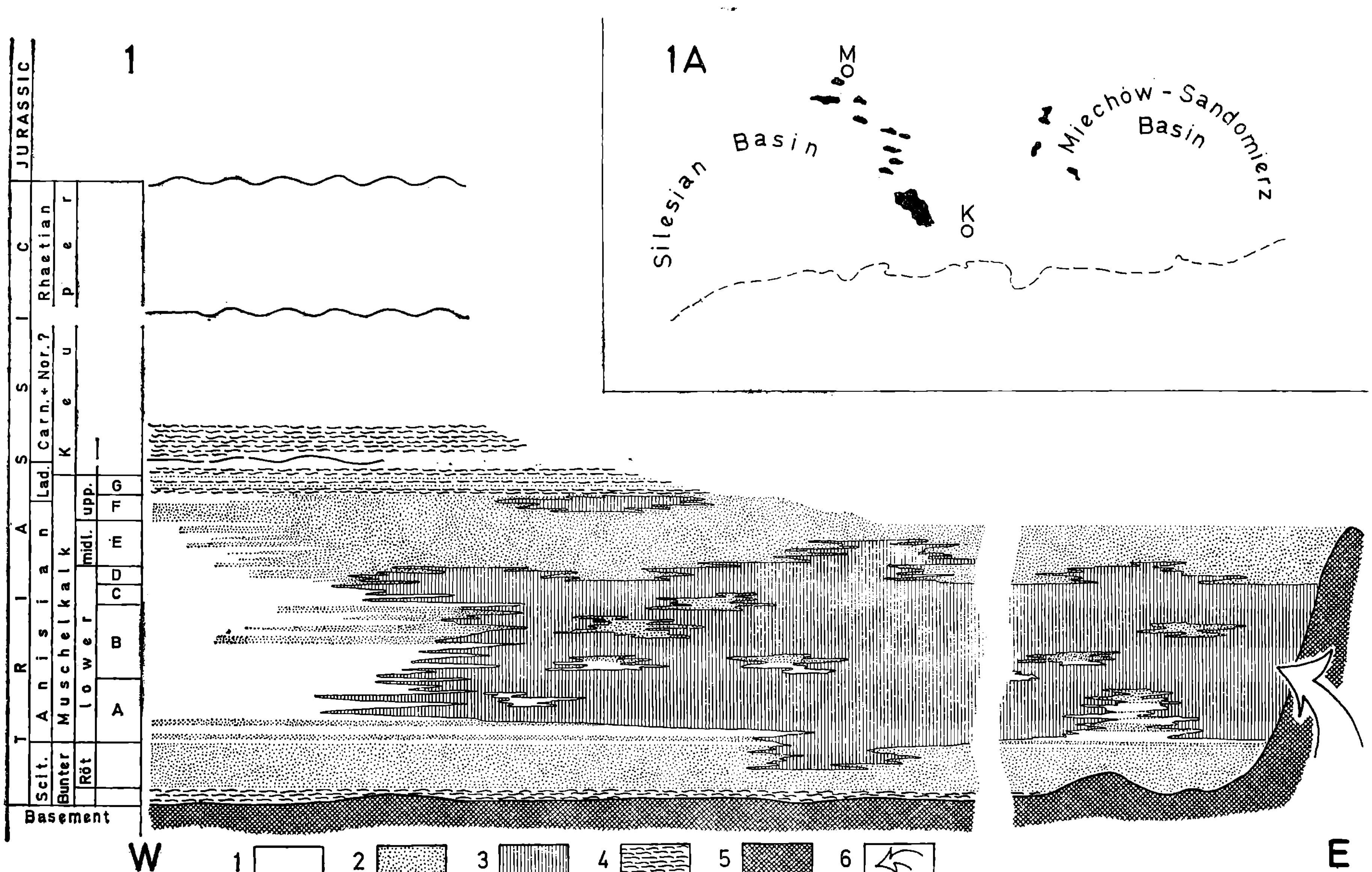
The problem of the ore-bearing dolomite has been traditionally centered around the question of „syngenetic" versus „epigenetic" origin. In recent years evidence has been accumulating in favour of epigenetic interpretation. Indeed, the metasomatic and cross-cutting contacts with limestones and early-diagenetic dolostones exclude the ore-bearing dolomite from the class of dolomites formed during the early stage of burial (see e.g. Traczyk, 1965; Goerlich and Szwaja, 1966; Śliwiński, 1969; Bogacz et al. 1972).

The ore-bearing dolomite, as we see it today, was formed after deposition of much if not all of the Muschelkalk sequence, although the bulk of this neosome appears to predate the Jurassic cycle of sedimentation and is older than the majority of faults that cut the Muschelkalk carbonates (for discussion and references see Bogacz et al., 1972).

Among the authors favouring the epigenetic interpretation no agreement has been reached as to the source of magnesium and the cause of dolomitization. The origins suggested invoke dolomization by; 1. descending late Triassic sea waters (Assmann, 1926, 1948; Ekiert, 1957; Śliwiński, 1966, 1969, Gałkiewicz, 1971). 2. the action of ground waters, whereby the magnesium is believed to have been leached out from remote dolomitic limestones or dolostones (Michael, 1913, Heweet, 1928; Stappenbeck, 1928; Krusch, 1929), 3. the action of magnesium-rich connate brines mobilized by, and mixed with hydrothermal solutions (Dżułyński and Kubicz, 1972), 4. descending saline brines derived from the overlying Miocene evaporites (Seidl, 1957, 1960; Keil, 1956) and 5. the introduction of magnesium ions from deep-seated sources by ascending hydrothermal and mineralizing solutions (Duwensee, 1928; Kuźniar, 1929; Sujkowski, 1958; Harańczyk, 1970, 1973; Pałys, 1967, and many others). Closely parallel hypotheses of origin have been advanced for many similar dolomites in other regions (see e.g.; Heweet, 1928; Ohle and Brown Edit., 1954; Schwartz, 1955).

The „sine-qua-non" of the above hypotheses, with the exception of „3", is a large supply of magnesium ions from sources situated outside the space occupied by the ore-bearing dolomite. In addition, most geologists have been satisfied with the opinion that the ore-bearing dolomite was formed by replacement of limestones. Indeed, the abundant metasomatic contacts between the dolomite and limestones were strong enough to establish this point of view as the prevailing hypothesis.

A new approach to understanding of the ore-bearing dolomite came when it was conceived that a considerable part of this neosome was formed at the expense of „primary", i.e. early-diagenetic dolostones (Bogacz et al., 1972; Sobczyński and Szuwarzyński, 1974). The road to this approach was paved by earlier investigators. In studying the overall facies pattern of the Muschelkalk in the Silesian Basin, many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1A
JURASSIC
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upper
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Silesian Basin
Miechów - Sandomierz Basin

authors have come to the conclusion that the facies grades from predominantly limestone in the west to predominantly dolomite in the east (see e.g. Assmann, 1944; Siedlecki, 1949; Gruszczyk, 1956). Admittedly, not always and not everywhere was the proper distinction made between the ore-bearing dolomite and the early-diagenetic dolostones (the necessity of such distinction was emphasized by Śliwiński, 1969). However, the conclusion that arises from many observations is that the amount of early-diagenetic dolostones in the Muschelkalk increases progressively upward in the section and toward the north-eastern and eastern margins of the Silesian Basin (Fig. 1). These margins, as already noted, are delineated by the Cracow-Myszków elevation of the pre-Triassic surface. Accordingly, the observed increase in the amount of early-diagenetic dolostones reflects the increasing proximity of shore-lines.

It is unnecessary, for our purpose, to review the current hypotheses of origin of early-diagenetic dolostones (excellent summaries of our knowledge on this subject have been presented by Fairbridge, 1958, and Friedman and Sanders, 1967, compare also Adams and Rhodes, 1960, Hsü and Siegenthaler, 1969). It is however, worth mentioning that the distribution of early-diagenetic dolostones in the Muschelkalk of the Silesian Basin agrees well with what is known of the distribution of many ancient and recent sediments of this type (see e.g. Cloud and Barnes, 1957). In addition, the overall character of the Muschelkalk sequence in the north-eastern and eastern parts of the Silesian Basin fits well all the requirements postulated for the formation of early-diagenetic dolostones in very shallow or supratidial „sabkha"

Fig. 1. Diagramatic cross-section through Muschelkalk in Silesian Basin (from west to east). Correlation with Alpine Triassic after Kozur, 1974 and Zawidzka, 1974. 1 — limestones; 2 — early-diagenetic dolostones; 3 — ore-bearing dolomite; 4 — sandy and argillaceous sediments; 5 — pre-Triassic rocks; 6 — presumed routes of ascending hydrothermal solutions. A — Gogolin beds, B — Gorażdże beds, C — Terebratula beds, D — Karchowice beds, E — Diplopora dolomite, F — Tarnowice and Wilkowice beds, G — Boruszowice beds

Fig. 1. Schematyczny przekrój utworów triasu basenu śląskiego (z zachodu na wschód). Korelację z triasem alpejskim przyjęto wg Kozura, 1974 i Zawidzkiej, 1974. 1 — wapienie; 2 — dolomity wczesnodiagenetyczne; 3 — dolomit kruszconośny; 4 — osady piaszczysto-ilaste; 5 — skały podłoża triasu; 6 — przypuszczalna droga dopływu ascenzyjnych roztworów hydrotermalnych. A — warstwy gogolińskie, B — warstwy gorażdżańskie, C — warstwy terebratulowe, D — warstwy karchowickie, E — dolomit diploporowy, F — warstwy tarnowickie i wilkowickie, G — warstwy boruszowickie

Fig. 1A. Schematic presentation of paleomorphology during Lower Muschelkalk time (after Alexandrowicz, Siedlecki, 1960 and Śliwiński, 1966). Black areas — islands. Dashed line — present margin of Carpathian flysh. K — Cracow, M — Myszków

Fig. 1A. Schematyczny szkic paleomorfologii przykrytej przez utwory dolnego wapienia muszlowego (według Alexandrowicza, Siedleckiego, 1960 i Śliwińskiego, 1966). Czarne pola — wyspy. Linią przerywaną oznaczono północną granicę Karpat fliszowych. K — Kraków, M — Myszków environments (compare Deffeys et al., 1965; Illing et al., 1965).

The ore-bearing dolomite is virtually restricted to the north-eastern and eastern part of the Silesian Basin where the original facies of the Muschelkalk was to a considerable degree primary, i.e. early-diagenetic dolostone. The remnants of early-diagenetic dolostones are preserved as relics within the ore-bearing dolomite. Accordingly, it appears legitimate to assume that a considerable part of the ore-bearing dolomite resulted from transformation of primary dolostones. For such transformation no additional supply of magnesium ions is needed. The transformation of this type is essentially a recrystallization process and the neosome produced in this manner may well be indicated as recrystallized dolomite. There may be some question as to the propriety of calling such a dolomite metasomatic. It should be borne in mind, however, that „recrystallization is really a special case of metasomatism in which the original and the replacing mineral are mineralogically identical although different in grain size, morphology and orientation" (Folk, 1959, p. 29).

It is difficult to estimate exactly how much of the ore-bearing dolomite resulted from recrystallization of early-diagenetic dolostones, but most of the upper parts of this neosome was formed at the expense of such dolostones. Such claim cannot be made with respect to the ore-bearing dolomite in the lower parts of the Górażdże Beds and in the underlying Gogolin Beds. The primary facies of these beds, even close to the emergent areas, was limestone (Fig. 1). Accordingly, the lower parts of the ore-bearing dolomite resulted from dolomitization of limestones. This rises a question as to the derivation of magnesium ions required for such replacement.

A study of contacts of the ore-bearing dolomite with the underlying limestones may be helpful in resolving this question. Such contacts are of two types; solutional and metasomatic contacts. The former are sharply defined solution surfaces representing the original floor of solution cavities. Such surfaces are, in places, veneered with residual „vitriol" clays (Horzemski, 1962) or with stratified cave ores (Sass-Gustkiewicz, 1974). The solution contacts are invariably associated with extensive collapse breccias developed in the ore-bearing dolomite (see Bogacz et al., 1970; Sass-Gustkiewicz, 1975).

Pertinent to our considerations, however, are metasomatic contacts. Such contacts take a shape of down-pending lobes, mottles and replacement veins spreading along bedding interfaces or cutting them at various angles. The above „contact configurations" represent a frozen penetration front of dolomitization and testify to lateral and downward movement of dolomitizing and mineralizing solutions (see Goerlich and Szwaja, 1966; Bogacz et al., 1972).

The implication of the downward movement is that the dolomitizing solutions were moving from that part of the section which originally was dolostone. The reason for downward migration was, most likely, the high density of dolomitizing solutions. Significantly, the lowermost boundary of the ore-bearing dolomite frequently coincides with that of sulfide mineralization (Bogacz et al., 1972). In such instances one may conclude that the dolomitization was nearly contemporaneous with the emplacement of sulfides and that magnesium ions have traveled together with heavy metals. The emplacement of sulfides was invariably associated with conspicuous dissolution of the dolomite (Bogacz et al., 1973). This is rather clear evidence that during the processes of mineralization considerable amount of magnesium ions were released. Accordingly, it is permissible to assume that the magnesium ions freed during mineralization and recrystallization of dolostones went into solutions and were actively involved in dolomitization of limestones.

In conclusion, rather than assuming a delivery from remote sources it is suggested that much of the magnesium ions required for the formation of the ore-bearing dolomite in the Triassic of the Cracow-Silesian region was derived from primary dolostones existing in the structural environment in which this dolomite was produced. This is certainly not to aver that limited amounts of magnesium ions could not have been derived from greater depth. Abundant dolomitic veins in the Paleozoic rocks of the area, and the localized dolomitization of the Jurassic limestones situated close to some mineralized fault zones (Harańczyk et al., 1971), indicate that the magnesium ions were carried to the surface by solutions rising from deep-seated sources. Such sources might have contributed to the formation of the ore-bearing dolomite.

From the foregoing it appears that the model suggested here for the ore-bearing dolomite embodies some aspects of the „solution cannibalization" concept as envisaged by Goodell and Garman (1969). It also bears similarities to explanations advanced with respect to some other secondary dolomites (see e.g. Ohle, 1951; Claveau et al., 1952; Fritz and Jackson, 1972). Parenthetically, it may be added that early-diagenetic dolostones that have been recrystallized and mineralized are known to occur in many other ore districts (see e.g. Ohle, 1951; Proctor, 1964; Vorin, 1965; Pawłowska, 1970; Fritz and Jackson, 1972).

The question that arises is now what was the cause of alterations that resulted in the appearance of the ore-bearing dolomite?

Any explanation of dolomites is primarily a problem in transfer of solutions. As indicated by Hanshaw et al. (1971 p. 720) „one thing that all environments have in common where dolomite is reported to be forming today is active circulation of solutions". Such solutions may differ greately in character and origin. For instance, saline brines or ordinary, magnesium-rich ground waters may be effective in dolomitizing of limestones, and it is recognized that „the process of dolomitization may take place while limestone is still in the sea or after it has been rised above the sea" (Van Hise, 1904 p. 802).

The fact that so many ore bodies of hydrothermal origin (80—90% according to Schwartz, 1955) have an envelope of coarse, secondary dolomites has led many authors to regard dolomitization as a hydrothermal alteration (see e.g. Heweet, 1928; Ohle 1951, Ohle and Brown Edit., 1954; Sujkowski, 1958, and many others). Let us recall at this place that also to many geologists who advocate the hydrothermal genesis of the Cracow-Silesian ores, the origin of the ore bearing dolomite is closely related to hydrothermal solutions. This is done chiefly on the assumption that the magnesium ions were delivered by ascending hydrothermal solutions and that the source of magnesium was the same as the source of metals.

It is not intended to enter here into the interminable controversy concerning the origin of sulfide ores in the Muschelkalk save to reaffirm the authors opinion, expressed in earlier publications (Bogacz et al. 1970, 1973, 1973 a) that these ores are of hydrothermal origin and that the ore-bearing dolomite resulted from the same processes whereby the ores were deposited. Thus stated, the ore-bearing dolomite belongs to the class of hydrothermal dolomites and represents a gigantic aureole of wall-rock alterations consequent upon the ingress of hydrothermal solutions. The formation of this dolomite may be envisioned as a front of alterations advancing ahead of and/or proceeding contemporaneously with the first wave of sulfide mineralization (compare also Ohle, 1951).

The question that now arises is what was the rôle of hydrothermal solutions in shaping of the ore-bearing dolomite?

While the foregoing considerations imply that the magnesium ions, save in inadequate amounts, were not delivered by ascending hydrothermal solutions, this does not mean that the passage of such solutions was not of primary consequence upon the formation of the ore-bearing dolomite. In discussing the effects of hydrothermal solutions upon limestone aquifers, Lovering (1969— p. 755) suggested that: „the formation of hydrothermal dolomites would be expected where ground waters became heated and started to circulate through limey environment".

The Lovering's model applies to limestone aquifers and is based on the assumption that the source of magnesia is primarily ground water. The principles of the Lovering's model can be applied to the problem of the ore-bearing dolomite. Let us consider the situation in which a predominantly dolostone aquifer is invaded by hydrothermal solutions. Under such conditions the passage of hydrothermal solutions and the transfer of ground waters mobilized by, and mixed with such solutions may and presumably will lead to recrystallization of primary dolostones and to dolomitization of limestones. This is, in principle, the model suggested here for the ore-bearing dolomite in the Triassic of the Cracow-Silesian region.

The dual nature of fluids credited with having effected the formation of the ore-bearing dolomite must be admitted at once. On one side there are hot mineralizing solutions on the other the activated ground waters that were started in motion by the ingress of hydrothermal solutions. It is difficult to distinguish between the action of hydrothermal and cold ground waters. Mingling of such waters is always possible (H e y l et al. 1959; F o r d and K i n g, 1965). They may operate separately or in conjunction. Due allowance should also be made for yet another possibility. The hot mineralized solutions might have been preceded by the moving front of unmineralized hydrothermal waters. The problems rised above are admittedly conjectural, but the dual nature of fluids involved in the formation of the ore-bearing dolomite as envisioned in our hypothetical model may account for the presence of recrystallized but notably barren parts of the ore-bearing dolomite.

The preceding discussion has set forth the possible manner in which the ore-bearing dolomite was formed. The question now arises; how and where the hydrothermal solutions gained access to the Muschelkalk carbonates?, in which direction they moved through the Muschelkalk?

Geologic evidence of the region indicates that the hydrothermal solutions credited here for effecting the ore-bearing dolomite rose on a broad front along the north-eastern margin of the Silesian Basin and then moved to the south and south-west through the Muschelkalk carbonates (this suggestion has been advanced as an alternative explanation by B o g a c z et al. 1970).

It has been suggested that the Cracow—Myszków zone marks the location of feeding channels through which the solution rose to the surface (E k i e r t, 1971; R u l s k i, 1974). Strong support to such conclusion is provided by the fact that this zone is associated with deep lineament (Rulski, 1974), and is characterized by the presence of igneous rocks and cut by a profusion of ore veins of diverse age (compare E k i e r t, 1957; H a r a ń c z y k, 1974, Ś l u s a r z, 1964, 1969; Piekarski, 1971; B a n a ś et al., 1972, and others). It is thus logical to assume that the hydrothermal solutions credited here with having effected the formation of the ore-bearing dolomite have found a passage upwards through fractured rocks of the Cracow—Myszków elevation (Fig. 1). The solutions which rose to the pre-Triassic surface could have gained access to the Muschelkalk carbonates through the previously mentioned overlap (B o g a c z et al., 1972). Then the solutions could spread to the south and south-west along the upper boundary of the Gogolin limestones, guided by porous early-diagenetic dolostones.

The above pattern of solution transfer fits well geologic evidence of the region. Admittedly, different opinions as to this question are also being held. R i d g e and S m o l a r s k a (1972), basing on trace element distribution, think that the solutions rose in the south-western part of the Silesian Basin and moved north-east. This hypothesis does not explain adequately all the structural relationships described above and is difficult to reconcile with field evidence.

The hypothetical model suggested in this paper for the ore-bearing dolomite is far from being complete and is fraught with uncertainties concerning the begining and the end of processes which brought about the appearance of this neosome. From the foregoing considerations it is not to be concluded that the dolomite was formed in one single geologic episode. On the contrary, the ore-bearing dolomite, as we see it today, resulted from several magnesium-building phases superimposed one upon another. Such superposition of different magnesium-building phases is of common occurrence in many other secondary dolomites (see F a i r b r i d g e, 1958).

To keep attention focused on the main subject of this article the present authors have deliberatedly refrained from discussing many pertinent questions such as the origin of ores and their relationship to the ore-bearing dolomite and the origin of hydrothermal solutions. These questions are beyond the scope of the present article. It is realized, however, that the hypothetical model of processes that resulted in the formation of the ore-bearing dolomite and the structural environment in which this neosome was produced are strikingly similar to many formation models suggested for the Mississippi Valley type of ores (compare J a m e s, 1952; O h l e, 1959, S n y d e r, 1968, in particular see Pellissonnier, 1967). There is nothing surprising in this similarity in view of the fact that the Cracow-Silesian ores belong to the above indicated cathegory of ores. It may well be recalled at this place that this specific class of Zn-Pb ores has also been referred to as the „Upper Silesia-Mississippi Valley type" of deposits (D u n h a m, 1950, p. 16).

Recapitulating once again what has been said in the preceding sections, the suggested model for the ore-bearing dolomite in the Cracow-Silesian region may be summarized as follows:

1. The ore-bearing dolomite was formed by recrystallization of early--diagenetic dolostones and by replacement of limestones.

2. The magnesium ions required for the formation of the ore-bearing dolomite were chiefly derived from early-diagenetic dolostones that existed in the structural environment in which the dolomite was formed.

3. The transformation of early-diagenetic dolostones and dolomitization of limestones was effected by a combined action of hydrothermal solutions and mobilized ground waters (presumably connante waters).

4. The transfer of ground waters was promoted by ingress of hydrothermal solutions.

5. The hydrothermal solutions rose through the Paleozoic and Precambrian rocks of the Cracow-Myszków elevation up to the Triassic-

-substratum interface and then spread out horizontally southwards and south-westwards guided by porous early-diagenetic dolostones.

6. The precise time of inception and the upper time limits of processes which brought about the appearance of the ore-bearing dolomite are not known. There is, however, a strong suggestion that the great bulk of this dolomite was formed after deposition of much if not all of the Muschelkalk, presumably during late triassic time.

The foregoing statements are not meant as a „final solution" to the problem of the ore-bearing dolomite that has troubled the mind of geologists since many years. We consider the above statements as intriguing possibilities that may provide a fertile ground for further investigations. The formational model as here suggested embodies also many ideas advanced previously by several investigators and in this respect is not entirely new.

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STRESZCZENIE

Celem opracowania jest rekonstrukcja środowiska strukturalnego procesów, które doprowadziły do powstania dolomitu kruszconośnego w triasie śląsko-krakowskim. Wykonane badania i obserwacje prowadzą do wniosku, że dolomit kruszconośny powstał przez zastąpienie wapieni i rekrystalizację wczesnodiagenetycznych (pierwotnych) dolomitów. Przypuszcza się, że magnez niezbędny do utworzenia się dolomitu kruszconośnego pochodził w znacznej większości z dolomitów pierwotnych, istniejących już wcześniej w środowisku strukturalnym. Proces przeobrażenia wczesnodiagenetycznych dolomitów i zastąpienia wapieni przez dolomit kruszconośny dokonał się pod wpływem roztworów hydrotermalnych i uruchomionych przez nie — wód gruntowych (przypuszczalnie reliktowych — „connante waters"). Tym złożonym roztworom przypisuje się uruchomienie jonów magnezu zawartego w pierwotnych dolomitach.

Roztwory hydrotermalne zostały doprowadzone do utworów wapienia muszlowego poprzez skały prekambryjskie i paleozoiczne budujące elewację Kraków-Myszków. Miało to miejsce na obszarze, gdzie utwory wapienia muszlowego spoczywają w przekraczającej niezgodności bezpośrednio na skałach podłoża. Stąd roztwory hydrotermalne rozprzestrzeniały się promieniście, poziomo w kierunku południowym i południowo-zachodnim, wykorzystując ośrodek porowaty, jakim były dolomity pierwotne, a także powierzchnie nieciągłości sedymentacyjnych.

Ścisłe sprecyzowanie dolnej i górnej granicy wieku procesu dolomityzacji nie zostało dokonane. Stwierdza się, że dolomit kruszconośny jest starszy od znacznej większości deformacji uskokowych. Wydaje się bardzo prawdopodobne, że ogromna większość dolomitu kruszconośnego na obsza-

rze śląsko-krakowskim powstała już po osadzeniu znacznej części, jeśli nie całego profilu osadów wapienia muszlowego, przypuszczalnie zaś u schyłku triasu.

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