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Schaffhausen, Januar 1959 Der Kassier: E. WITZIG

Revisorenbericht über das Rechnungsjahr 1958

Die unterzeichneten Revisoren haben die Jahresrechnung 1958 der Schweizerischen Geologischen Gesellschaft geprüft und in allen Teilen in Ordnung befunden. Sie überzeugten sich von der gewissenhaften Verbuchung der Einnahmen und Ausgaben und deren Übereinstimmung mit den Belegen.

Die auf den 31. Dezember 1958 in der Bilanz aufgeführten Aktiven sind durch Bank- und Postcheckausweise belegt und die Ausscheidung der Vermögenswerte auf die einzelnen Fonds ist in der Kartothek übersichtlich dargestellt. Der zusammenfassende Rechnungsbericht stimmt mit der detaillierten Buchführung überein.

Die Rechnungsrevisoren beantragen der Gesellschaft, die Jahresrechnnng 1958 zu genehmigen und dem Herrn Kassier für die der Gesellschaft geleistete grosse und zeitraubende Arbeit bestens zu danken.

Schaffhausen, 28. Februar 1959 Die Revisoren:

J. PORTMANN F. HOFMANN

B. 75e Assemblée générale

Samedi, le 12 septembre 1959

Séance administrative, à 9 h, salle XVI, Palais de Rumine, Lausanne

1) Rapport du Comité. Le président, M. H. BADOUX, donne lecture du rapport du Comité pour l'exercice 1958–59, qui est approuvé par l'Assemblée.

2) Rapport du rédacteur. M. NABHOLZ fait part à l'Assemblée que le fascicule 52/1 vient d'être envoyé aux membres. Du vol. 51, les fascicules 1 et 2, ainsi que l'index pour les vol. 41 à 50 ont paru, alors que le fascicule extraordinaire 51/3, qui contiendra le compte rendu du Congrès de sédimentologie, est encore à l'impression. Les frais d'impression des fascicules parus s'élèveront à Fr. 38000.–, dont Fr. 21000.– à la charge de la Société. La Société est heureuse de pouvoir remercier divers fondations et auteurs des subsides reçus pour les frais d'impression.

3) Rapport du trésorier. M. WITZIG présente les comptes pour 1958, qui accusent un petit déficit de Fr. 700.–. Ce déficit n'est pas réel, puisque Fr. 7500.– ont été versés au fonds de réserve. Les comptes, ainsi que le rapport des vérificateurs MM. PORTMANN et HOFMANN, sont approuvés.

Le budget 1959 prévoit l'emploi du fonds de réserve, de Fr. 26000.–, pour l'impression du fascicule de sédimentologie. D'après les statuts, ce fonds de réserve devait précisément assumer des charges extraordinaires de ce genre. Compte tenu de la liquidation – que nous espérons provisoire – de ce fonds, le budget est équilibré, et il est approuvé par l'Assemblée.

4) Fixation de la cotisation annuelle et de la cotisation de membre à vie. Sur proposition du Comité, les montants des cotisations restent inchangés.

5) Divers. M. PORTMANN, dont le mandat arrive à terme, est remplacé, comme vérificateur des comptes, par M. R. HERB.

Le secrétaire: R. TRÜMPY

Séance scientifique, samedi le 12 septembre 1959

Séance simultanée de la section de géologie de la S. H. S. N.

1. – HENRI MAYOR (Lausanne): **Contribution à l'étude de la morphologie du Plateau vaudois.** Paraîtra plus tard.

2. – JOSEPH KOPP (Ebikon): **Alte Flussläufe der Muota und Steiner Aa zwischen Rigi und Rossberg.** Kein Manuskript eingegangen.

3. – LEON MORNOD (Bulle): **Quelques notes d'hydrologie souterraine jurassienne.** Un résumé paraîtra dans les Actes de la Soc. Helv. Sc. nat., (1959).

4. – LOUIS BENDEL (Luzern): **Die Methoden zur Untersuchung von Rutschungen.** Erscheint in den Verhandlungen SNG, Lausanne (1959).

5. – B. CAMPANA (Australien): **Sur quelques conglomérats à uranium et cuivre des séries paléozoïques et précambriennes de l'Australie, Tasmanie et Canada.** Pas reçu de manuscrit.

6. – FRANZ HOFMANN (Schaffhausen): **Sedimente einer ariden Klimaperiode zwischen Siderolithikum und Molasse in Lohn, Kanton Schaffhausen, und am Rheinfall.** Erscheint in Eclogae geol. Helv., Vol. 53/1 (1960).

7. – NICOLAS OULIANOFF (Lausanne): **Problème du Flysch et géophysique.** Paraîtra dans les Eclogae geol. Helv., Vol. 53/1 (1960).

8. – G. CHRISTIAN AMSTUTZ (University of Missouri, School of Mines and Metallurgy, Rolla, Missouri): **Polygonal and Ring Tectonic Patterns in the Precambrian and Paleozoic of Missouri, U.S.A.** (with notes on their rejuvenation and relation to the major ore deposits of the area)*). With 3 figures in the text.

ZUSAMMENFASSUNG

Polygonale und ringförmige Strukturen in Missouri werden in einen weiteren Rahmen gestellt. Es wird vorgeschlagen, dass die Zellenkonvektionstheorie die beste Arbeitshypothese sei für die genetische Erklärung der ringförmigen Strukturen, deren Zahl und Grösse vom Präkambrium bis zum Quartär deutlich abzunehmen scheint.

SUMMARY

Polygonal and ring shaped fault and/or ring dyke patterns of the Precambrian and the Paleozoic of Missouri are shown to be probably due to original and to rejuvenated circular tectonic patterns which formed in the primordial crust of the earth.

1. INTRODUCTORY REMARKS

The tectonics of relatively young orogenic belts such as the Alps, the Cascades, the Appalachians, the Peruvian Andes etc. appear to be basically different in some respects from the tectonics of shield areas. For a better understanding and analysis of some geologic features in the middle West, i. e. of polygonal and ring patterns occuring in the Precambrian and the Paleozoic of Missouri, analogies from other shield areas and from the moon prove to be useful. So far these analogies yielded promising results and it appears worth-while to offer a brief progress report. Some of these features are geometrically associated or coincide with some of the rich Pb-, Zn-, and Fe-deposits.

2. OBSERVATIONS

The geologic map of Missouri and some neighboring areas show some conspicuous polygonal or ring patterns. They appear to be more or less connected with the linear patterns in the area, such as the NW–SE faults. Seen in the third dimension they are sets of ring or polygonal fault systems and/or ring dykes. The four best-known examples and a few less conspicuous ones are briefly described here to illustrate the above statements.

a) The structure of the *Iron Mountain Mine* in Southeastern Missouri consists of one, and possibly more ring dyke shaped bodies which represent the ore zones. The main cone shaped body pictured on figure 1 measures approximately one kilometer across. Branches of other rings cut by mining and drilling indicate that a multiple system of neighboring ring dykes may be present. The most detailed structural account was published by LAKE in 1933. Recent mine maps confirm and strengthen the picture of a multiple ring-dyke system. The spilitic genesis of this ring-dyke iron deposit was described in detail by GEIJER in 1931. The time sequence study of the rocks and the ore minerals shows a series of fault movements with

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brecciation of the wall rock and contemporaneous injections of the hydromagmatic ore fluid. Metasomatic replacements play a transitional and marginal role only.

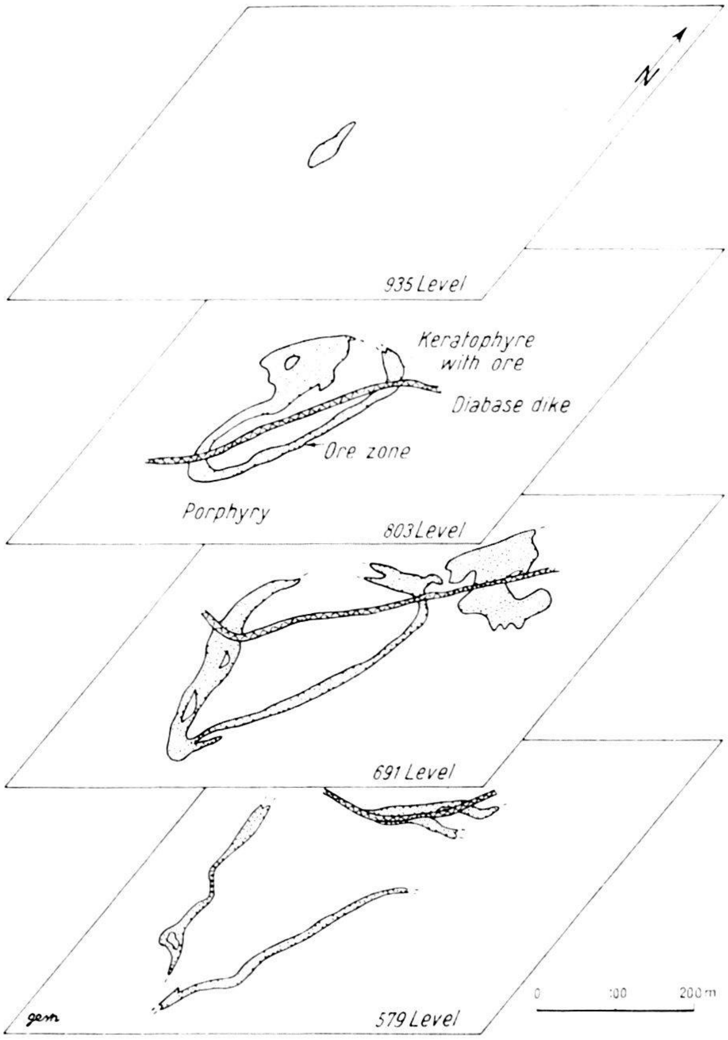

Fig. 1. The cone shaped ring dyke ore body of the Iron Mountain iron deposit in the Precambrian porphyries of SE-Missouri, U.S.A. Courtesy: Ozark Ore Company.

b) The Crooked Creek structure a few miles south of Steelville, Central Missouri (fig. 2). Here a multiple polygonal fault system was mapped by various geologists. HENDRIKS (1954) presented the most detailed account and map. The various concentric sets of polygonal fault systems create a pattern of semi-circular horsts and graben. It is cut in the center by one conspicuous twin fault which created a linear horst. At the northern end of it are small lead and barite deposits. Vertical offset distances or throws measured along the fault planes amount in various cases to about 150 m. This pattern shows up in the topography and the vegetation. The time sequence study of the faults shows that rejuvenated movement has taken place over a long period of time. The Wells Creek Basin structure pictured and described by BUCHER (1936) and also reproduced by EARDLEY (1951; p. 237–240) is remarkably similar to the Crooked Creek structure.

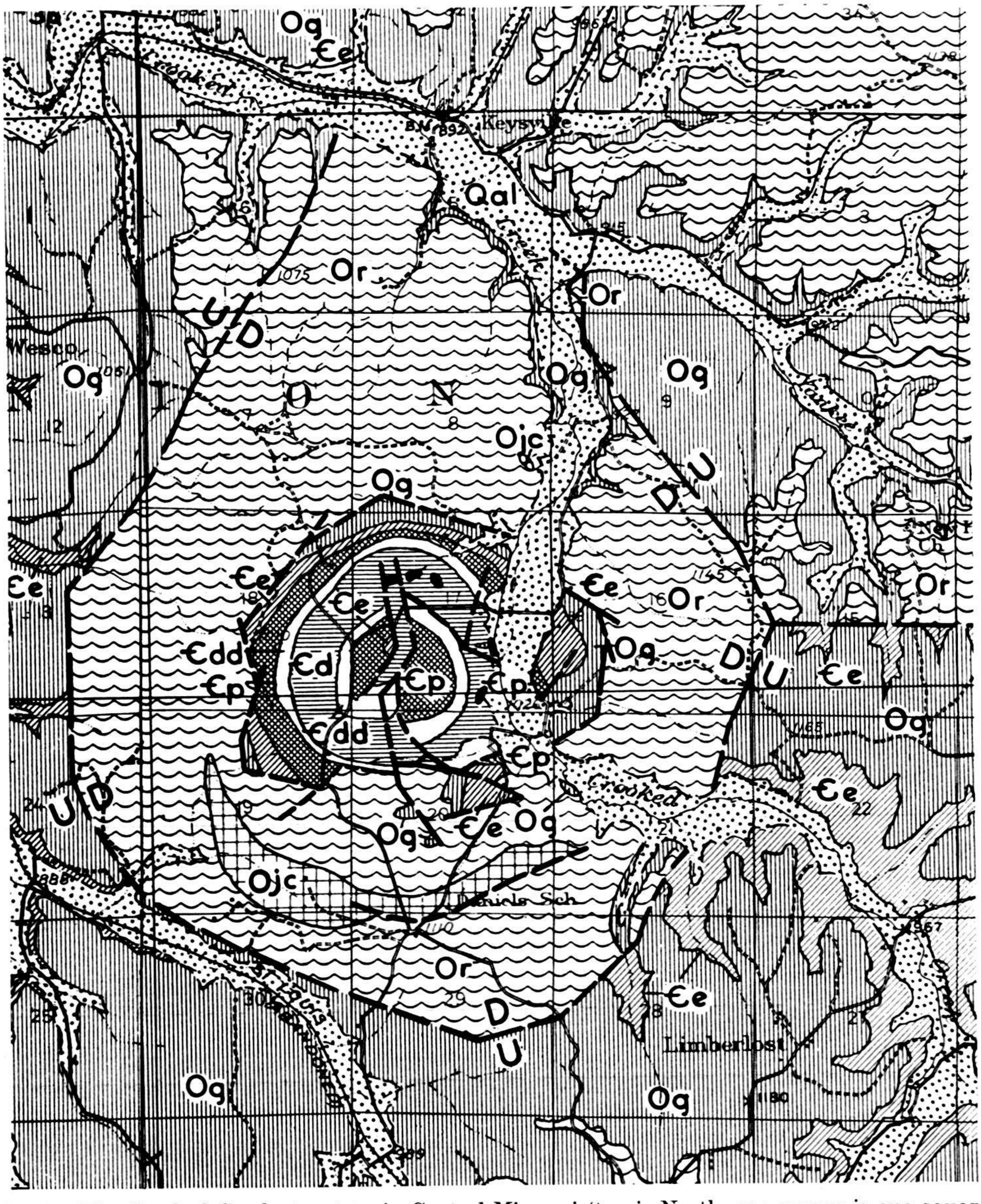

Fig. 2. The Crooked Creek structure in Central Missouri (top is North, one square is one square mile). Geological column below; the heavy broken lines are faults (high angle, approximately located). Copied from HENDRICKS, 1949.

Column (legend)

Era:	System:	Formation:	Symbol:
Cenozoic	Quarternary	Alluvium	Qal
Paleozoic	Lower Ordovician	Jefferson City	Ojc
		Roubidoux	Or
		Gasconade	Og
	Upper Cambrian	Eminence	Ee
		Potosi	Ep
		Derby-Doerun	Edd
		Davis	Ed
		Bonne terre (black spots)	Eb

c) The fracture patterns in the Tri-State district (Missouri, Oklahoma, Kansas), the largest zinc-district of the world. Here the "ore zones" represent usually polygonal fault and brecciation lines or "zones" which are connected with each other and form a network. The throws are around 50–100 m, in various cases along the major linear faults considerably more. This region has been described extensively (compare for example WEIDMANN, 1933). The time sequence analysis shows repeated movement along the fault lines and repeated brecciation and ore mineral deposition[1]).

d) The fourth ring type structure is the Decaturville structure, Camden and Laclede Counties, Missouri. This structure opened up the Paleozoic down to the Precambrian. It was described by W. BUCHER (1936) as a cryptovolcanic structure together with 5 other circular structures in the central stable region of the U. S. A. not including the Crooked Creek structure.

Additional areas which are less known structurally or less conspicous, are numerous and deserve more attention. The circular patterns of high grade Pb and Pb-Cu-Ni-Co-ores in the «Lead Belt» in SE-Missouri, the largest Pb-district of the world, are probably caused by the circular shore lines and reefs around the Precambrian knobs (compare BUCKLEY 1909, BÜHLER 1933, OHLE and BROWN, 1954, and others). However, some of these knobs may owe their ring shape not only, or not so much to erosion than to horst and graben tectonics. And the faults may have been the channelways for the de-gassing which then lead possibly to an exhalative syngenetic feeding of ore solutions as suggested previously (AMSTUTZ 1958, p. 236). Similar semi-circular tectonic or possibly crypto-tectonic patterns are known from other areas of the middle west; for example the Illinois fluorspar district (see BASTIN 1933), the Wisconsin-Illinois-lead district (Wisconsin-Illinois-Jowa-Tri-State area). The patterns described by BUCHER (1936) as cryptovolcanic structures also join in to this family of ring or polygonal patterns in the middle west, as mentioned above; and so does the Magnet Cove area in Arkansas.

Two elements of the above summarized observations deserve special attention. First the association of ore deposits of remarkably monotonous composition with these areas, and secondly the fact that these tectonic patterns are not restricted to the Precambrian basement. The first observation could be explained with a subcrustal and possibly old differentiation process which differs from processes leading to ore fluids in orogenic belts. Among the long list of physical forces which may lead to differentiations and concentrations in a liquid substratum, electrical currents may be the most effective ones. They may lead to a horizontal migration-differentiation and concentration of the rarer metallic constituents in the earth's liquid layers in primordial times (and possibly also now!), i. e. in RITTMANN's (1947) solar matter, in the pneumatosphere and in the original and now subcrustal basaltic layer.

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[1]) The term "mineralization" is here not used because of its common dogmatic epigenetic or exogenetic connotation. "Mineralization" or ore deposition may take place syngenetically or endogenetically, in situ and autigenically, and ore solutions are not always brought in from an outside source ("*by the stork*"). As was shown recently by the author (1959b) numerous relationships speak for a syngenetic and endogenetic origin of ore deposits with predominantly congruent features.

The second feature strongly suggests that vertical polygonal tectonic adjustments in shield areas took place after the Precambrian (and probably still today). Rejuvenations of old fractures are common, even in the horizontal tectonics of orogenic belts. The Crooked Creek structure in Missouri could be explained as a primary, or a rejuvenated polygonal vertical adjustment of the basement and the overlaying horizontal Paleozoic sediments.

It is obvious, already from the few cases mentioned from the middle west that there appears to be a distinct function between the shape of the fault patterns and the strength, homogeneity, fabric, etc. of the rock material. Massive (igneous or highly metamorphosed) rocks appear to break «concoidally», i. E. more or less circularly. Layered rocks (sediments, lava flows) appear to break more often in more or less straight lines and thus in a polygonal way.

3. ANALYSIS BY ANALOGY

The natural sciences have two ways, two major methods of approaching the truth, of finding a preliminary or advanced answer: One, the detailed physical, chemical, and mathematical analysis of a phenomenon as such; and two, the comparison of the phenomenon in question with known similar or identical phenomena elsewhere, in identical, similar, or different environments. Usually both methods should be used and the results confronted. For the purpose of this preliminary communication the second method is applied. Analogous features were found in the Precambrian areas of the earth, and on the moon.

a) Other Areas of the Earth's Crust: in other Precambrian areas ring dykes are fairly common and were described by many authors. A bibliography on ring dykes and polygonal fracture systems would fill many pages. A selection of some well known and well described and pictured occurences will be mentioned here.

Jacobson, et. al. (1958) described and pictured ring-complexes in the younger granite province of northern Nigeria. Many circular, semi-circular and complex ring fractures are in this area, cutting more or less vertically through the basement and produced surface features which are considered to be «some of the finest examples of granite ring-complexes in the world» (p. 5). On Plate VII these authors offer an overall map of the area which contains some 18 ring dykes, extrusions, and intrusions. In a series of crossections (their fig. 8) it is shown that re-juvenation by repeated circular fracturing and intrusion or extrusion is common. It is interesting to note (see the following section on the moon) that the later ring fractures are practically always smaller than the older ones.

Frances M. Delany (1955) also described sets of ring structures from Africa. These occur in the Northern Sudan. Just as in Nigeria they usually exhibit repeated activity, both tectonic and magmatic, often with interesting trends of differentiation. Two excellent air photographs illustrate the surface features with the pronounced circular pattern which, in some cases, stand out as high as several hundred meters above the desert surface. The average diameter of the first generation ring, which again is as a rule the largest feature, is 4 to 20 km.

Garson (195 ?) reported about agglomeratic carbonatite dykes filling ring structures in Nyasaland (Trans. Geol. Survey Nyasaland, 5p.). Krenkel (1957) descri-

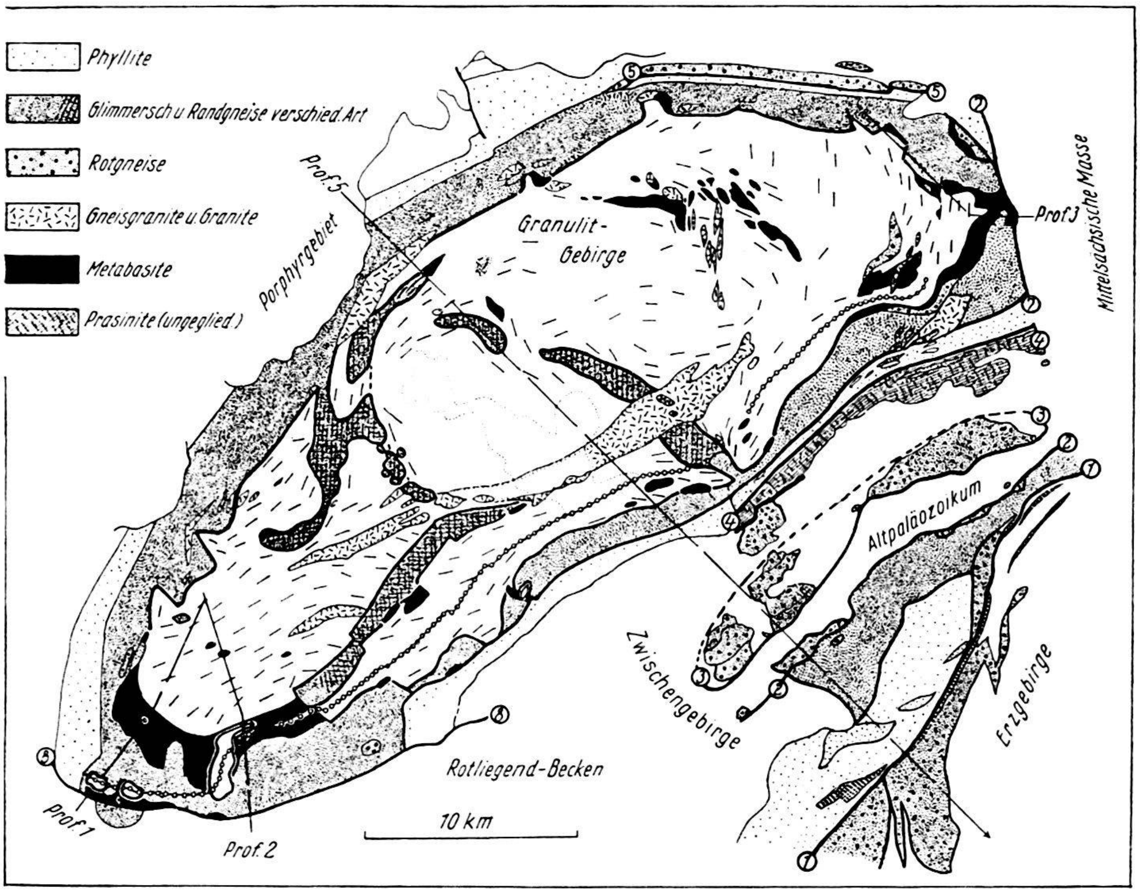

Fig. 3a. Tectonic and petrographic map of the granulite massive in Saxony, a multiple ring pattern. (After SCHEUMANN, 1935, p. 275). Nach neuesten Untersuchungen von WINOGRADOW, et al. 1959, lassen sich in Sachsen meistens drei intrusive Zyklen unterscheiden, wobei die wichtigsten Vererzungen mit dem dritten, obervariszischen Zyklus zusammenhängen.

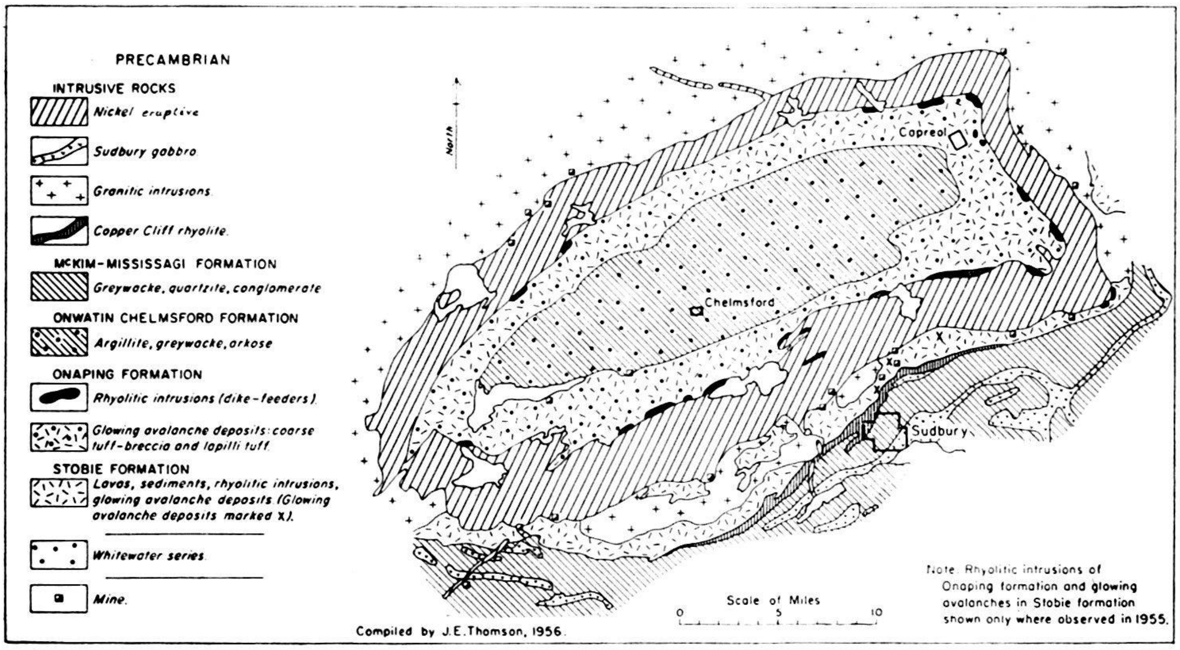

Fig. 3b. Tectonic and petrographic map of the Sudbury basin or ring dyke in Canada, a simple ring pattern (after THOMSON and WILLIAMS, 1959, p. 4).

bed and mentioned various ring dykes, fractures or intrusions from Africa, particularly from the South, in his book on the geology and the ore deposits of this continent (p. 253, 254, 278, 279, 306, 312, 436). Possibly the most remarkable ring pattern is the Vredefort ring in South Africa, described in detail by Brock (1951).

Various ring complexes are also known from Scotland and Ireland. A granitic ring-complex in Ireland was for example described by Pitcher (1953). In addition to these ring structures, circular patterns are of course also produced by simple intrusions. A classical example is – to mention only one of many similar areas – the group of circular intrusions in Cornwall, S. W. England.

In Russia and Canada, ring dykes and structures are also abundant and cannot be enumerated here. It is interesting to note that in recent years Thomson and Williams (1959) advanced the idea that the Sudbury complex may be a ring dyke. Whether or not this is the case, the structure of the basin with its steep slopes, is certainly an oval or polygonal ring-type pattern and may well be mentioned here. Almost identical with the Sudbury complex is the oval pattern of the granulite mountains in Saxony, Germany, which has also basic intrusives and extrusives with nickel ores. A comparison of the two maps is perplexing (figures 3a and 3b). The geographic orientation (SW–NE) the size, the overall pattern and to a large extent also the petrology are the same. The Bushveld basin might also be mentioned here although its rims are not nearly as clearly fractured and intruded by dykes etc. Nevertheless the depression is oval and may have been caused by a similar process at depth.

From these examples it may seem that smaller ring complexes are almost always produced by more acidic rocks whereas larger ones are formed by basic magmas. The relationship is, however, not so simple, although it is true that all larger ones (over 30 km in diameter) are accompanied by basic rocks. A preliminary statistical comparison of some fifty ring or polygonal patterns with their geological age showed a marked decrease from the Precambrian to the Mesozoic and Tertiary. This fact suggests that most of these structures may date back to the very beginning of the formation of the crust and that most if not all of the younger ones are due to rejuvenations of movements along old fractures.

It may prove useful to pay more attention to the nature and history of certain ring shaped structures, including those in younger rocks (for example the Nördlinger-Ries and semi-circular patterns in the Alps).

b) Analogies with the Crust of the Moon: The geometric similarity of the circular or semi-circular dykes, and intrusions and/or fracture patterns with the «moon craters» is striking and has lead Suess (1909) and Sacco (1913) and possibly also earlier workers to a comparison between graben, horst, ring and polygonal tectonic features on the earth and on the moon.

The more recent studies of Spurr (1944), and in particular the outstanding systematic tectonic analysis of Bülow (1954, 1957) brought the geometric evidence to a point where an endogenetic tectonic explanation for the moon craters can be considered to be the most objective hypothesis. The meteor impact theory is, as was shown by this author (1959a) an excellent illustration of the continued overriding of objective, logical evidence by archetypal subconscious patterns during the crucial step of interpretation of observations. As was shown, this influence is especially strong in geological theories, whereas chemistry has done away with it largely when it grew out of alchemy. The assumption of a powerful influence or intervention from the outside, in form of an impact, an invasion, an injection, etc., thus of an epigenetic or exogenetic process, as compared with a syngenetic or endogenetic evolution, is subconsciously suggested to us, and supported by our subconscious affinity to this archetype. A good portion of all scientific progress is the gradual victory of objective approaches against the despotic, dogmatic grip which these subconscious patterns have on us.

There are of course interactions between the units of the universe and the earth; but an endogenetic or syngenetic explanation of an observation of a phenomenon which has formed in the past (thus an explanation from forces, processes, properties etc. which are innate, connate, inherent to a system) requires usually about one third only of the assumptions needed for an exogenetic or epigenetic theory, and is thus per se more probable.

The details of the analogy between the lunar features and the earth's crust are striking. The maria are surrounded by sets of arch-shaped faults, rows of volcanoes, continental shelves etc. The graben and horsts of the maria and the highlands («continental areas») also show the same tectonic features. It is only the perfection of circularity of the craters which is somewhat different from the aforementioned ring dykes and intrusions on the earth's crust. However, many observations point to the fact that the lunar crust is much more homogenous than the polygenetic material which forms the earth's crust. Stress and fracture patterns develop in an inhomogenous way in inhomogenous ground.

The mechanics causing ring-type tectonics may have various origins. WASIUTYNSKI (1946) explains them as «covers of convection cells which have been weakened through tensional and centrifugal deep crustal transport, with erected and at the same time deep rim walls of transported material» («durch Zerdehnung und zentrifugalen tiefkrustalen Transport geschwächte Decken konvektiver Zellen mit aufragenden und zugleich tiefreichenden Randmauern aus dem transportierten Material», p. 132), where he discusses the Puiseux-net of the moon (HAVEMANN 1957, p. 132–133). He interprets this net as a product of the still plastic crust which was swimming on a liquid substratum starting at about 45 km depth. The question whether this mechanism takes place also on a small scale is open. SONDER (1956) shows with his theory of rhegmagenetic fracture systems that torsional forces in the earth's crust set up nets of fractures. These look very much like the ones known from Missouri and adjacent areas. On the earth as well as on the moon they are younger than the oldest ring patterns.

As pointed out, the ring dyke patterns described by DELANY, PITCHER, KRENKEL, JACOBSON et. al., and many others ressemble or correspond to patterns on the moon, and so do the patterns from Missouri briefly described above. A mine map of certain Tri-State areas looks strikingly similar to the Puiseux-net with polygonal tectonics in the Ptolemäus region on the moon. The difference in scale is obviously irrelevant since fracture patterns are a matter of proportions, not of scale. Only the genetic discussion has to consider also the scale.

At Iron Mountain and in the Tri-State district the net-like nature of the polygonal pattern is known to a certain extent. However, if the occurence of such patterns is not just of an accidental local nature, it will be of high practical value and should serve as an excellent exploration guide. Elsewhere the present author states and explains the idea that the Mississippi Valley type deposits are possibly of exhalative volcanic nature, and the intraformational brecciation is shown to be due probably to frequent earthquakes. The partly polygonal graben and horst nature of the Precambrian shield in the middle west may have provided ample path for volcanic exhalations. The Iron Mountain, Pilot Knob, Pea Ridge, and probably all other Missouri iron deposits are of hydromagmatic, spilitic nature, as shown by GEIJER (1931) for the Iron Mt. deposit. Thus these are also volatile-rich magmas involved in ore deposition, and their presence may have played an important rôle in the formation of the polygonal patterns. Convection is stronger and more effective in volatile rich melts. The problem of ore genesis in Pre-Cambrian areas should be approached from a somewhat different angle than ore genesis in young orogenic belts. Certain features of these differences were already mentioned in the Symposium of the 17th International Geological Congress on «The Pre-Cambrian and the Mineral Deposits in the Regions of its Development» (1937).

4. SUMMARY – CONCLUSIONS

In summary, we may conclude therefore that the polygonal and ring shaped fault and/or ring dyke patterns of the Precambrian and Paleozoic of Missouri may be additional examples of the original and partly rejuvenated circular tectonic patterns typical for the primordial planetary crust of the earth. The subcrustal mechanism responsible for these structures may be convection currents as shown by WASIUTYNSKI (1946) and HAVEMANN (1957). Both, the actual size and formation as also the rejuvenation of these vertical tectonic disturbancies appear to have decreased considerably since Pre-Cambrian time.

5. BIBLIOGRAPHY

AMSTUTZ, G. C. (1958): *The genesis of the Mississippi Valley type deposits, U. S. A.* Experientia – *14*/7, p. 235–237.
– (1959a): *Syngenese und Epigenese in Petrographie und Lagerstättenkunde.* Schweiz. min. petr. Mitt. *39*, p. 1–84.
– (1959b): *Syngenetic zoning in ore deposits.* Proc. geol. Assoc. Canada, *11*, 14 p.
BASTIN, E. S. (1933): *The fluorspar deposits of Southern Illinois.* 16th Int. Geol. Congr., Guidebook 2, p. 56–57.
BROCK, B. B. (1951): *The Vredefort Ring,* Trans. geol. Soc. S. Africa, *53*, p. 131–157.
BUCHER, W. H. (1936): *Cryptovolcanic structures in the United States* (with discussion). 16th Internat. Geol. Congr. Rept. *8*, p. 1055–1084.
BUCKLEY, E. R. (1909): *Geology of the disseminated lead deposits of St. François and Washington Counties.* Missouri Bur. Geol. and Mines [2nd ser.] *9*, 2pts., 259 p.
BUEHLER, H. A. (1933): *The disseminated-lead district of South-eastern Missouri.* 16th Int. Geol. Congr., Guidebook *2*, p. 45–55.
BÜLOW, K. V. (1954): *Die Urkruste des Mondes und der Erde.* Wiss. Z. Univ. Rostock Jg. *4*, math.-nat. Reihe Nr. 1.
– (1957): *Tektonische Analyse der Mondrinde.* Geologie (Berlin), *6*, H. 6/7, p. 565–609.
DELANY, F. M. (1955): *Ring structures in the northern Sudan.* Eclogae geol. Helv. *48*, p. 133–148.
EARDLEY, A. J. (1951): *Structural Geology of North America.* Harper, p. 237–240.
GEIJER, P. (1931): *The iron ores of the Kiruna type.* Sver. Geol. Undersök [Ser. C, Nl] *367*, p. 1–39.

HAVEMANN, H. (1957): *Transgression-Regression und Konvektion.* Ge.ol. Berlin, *6*, p. 123–140.

HENDRIKS, H. E. (1954): *The Geology of the Steelville Quadrangle, Missouri.* Missouri geol. Survey *36* [2nd ser.], p. 32–70.

JACOBSON, R. R. E., W. N. MACLEOD & R. BLACK (1958): *Ring complexes in the younger granite province of northern Nigeria.* Geol. Soc. London, Memoir No. *1*, 72 p.

INTERNATIONAL GEOLOGICAL CONGRESS (1937): *The Pre-Cambrian and the mineral deposits in the regions of its development.* 17th Intern. Geol. Congress, Moscow, p. 64–80.

KRENKEL, E. (1957): *Geologie und Bodenschätze Afrikas.* Leipzig, 597 p.

LAKE, M. C. (1933): *The iron-ore deposits of Iron Mountain, Missouri.* 16th Int. Geol. Congr., Guidebook 2, p. 56–57.

OHLE, E. L. & J. S. BROWN (1954): *Geologic problems in the Southeast Missouri lead district* Bull. geol. Soc. Am. *65*, p. 201–222.

PITCHER, W. S. (1953): *The Rosses granitic ring complex, County Donegal, Eire.* Proc. geol. Assoc. *64*, p. 153–82.

RITTMANN, A. (1947): *Die prägeologische Pneumatosphäre und ihre Bedeutung für die geologischen Probleme der Gegenwart.* Experientia *3*/8, p. 1–15.

SACCO, F. (1913): *Selenologie oder Mondkunde.* In: Handwörterbuch Naturw. g, p. 1–12.

SCHEUMANN, K. H. (1935): *Die Rotgneise der Glimmerschieferdecke des sächsischen Granulitgebirges.* Ber. mathemat.-phys. Klasse sächs. Akad. Wiss., Leipzig, *87*, p. 251–286 (fig. 8).

SONDER, R. A. (1956): *Mechanik der Erde.* Stuttgart. p. 110–138.

SPURR, J. E. (1944): *Geology applied to selenology; the Imbrian plain region of the moon.* 112 p., 23 figs., 4pts. (Priv. publ. ?).

SUESS, E. (1909): *Das Antlitz der Erde.* III/2. Leipzig und Wien.

THOMSON, J. E. (1957): *Geology of the Sudbury basin.* Sixty-fifth Ann. Rep. Ontario Dept. Mines, *65*, part 3, 1956, p. 1–56.

THOMSON, J. E. & H. WILLIAMS (1959): *The myth of the Sudbury Lopolith.* Canadian Min. J., March *59*, 6 p.

WILLIAMS, H. (1957): *Glowing avalanche deposits of the Sudbury Basin.* Sixty-fifth Ann. Rep. Ontario Dept. Mines, *65*, part. 3, 1956, p. 57–89.

WASIUTYNSKY, J. (1946): *Studies on hydrodynamics and structure of stars and planets.* Astrophysica Norvegica, Bd. 4, Oslo.

WEIDMANN, S. (1933): *The Tri-State Zinc-Lead Region.* 16th Int. Geol. Congr., Guidebook *2*, p. 74–91.

WINOGRADOW, A. P., A. J. TUGARINOW, V. V. ZHIROWA, S. I. SYKOW, K. G. KNORRE & V. I. LEBEDEW (1959): *Über das Alter der Granite und Erzvorkommen in Sachsen.* Freiberger Forschungshefte C*57*, p. 73–85.

Note added to proofs: The excellent study by A. DAUVILLIER (1958), Le volcanisme lunaire et terrestre (Paris), was received only after completion of this paper.

9. – RENÉ HERB (Zürich): **Die Flyschfüllung der Fliegenspitzmulde bei Amden.** Erscheint in Eclogae geol. Helv., Vol. 53/1 (1960).

10. – ARNOLD BERSIER (Lausanne): **Un chenal d'érosion fossile dans l'Oligocène du pied du Jura vaudois.** Pas reçu de manuscrit.

11. – ARNOLD BERSIER (Lausanne): **Un mouvement tectonique synsédimentaire d'age aquitanien.** Pas reçu de manuscrit.

12. – THEODOOR RAVEN (Liban): **Dérive continentale causée par courants dans le substratum.** Paraîtra dans les Eclogae geol. Helv., Vol. 53/1 (1960), sous le titre: Alpine Folding as related to continental drift.

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