

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/225983106>

# Fractal properties of multi-order folding as a tool for exploration of low-grade banded iron ores in the Kirivoy Rog Basin (Ukraine)

Article in *Geologische Rundschau* · March 1996

DOI: 10.1007/BF00192054

CITATIONS

6

READS

19

2 authors, including:



Dmitrii A. Kulik

Paul Scherrer Institut

125 PUBLICATIONS 3,071 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



GEMS TM: Gibbs Energy Minimization Software for Thermodynamic Modelling [View project](#)



The MINES thermodynamic database for modeling crustal fluid-rock systems [View project](#)



SEARCH FOR

GO Advanced Search Search Tips

SWI-Schweiz KAP 644738

AUTHOR OR EDITOR PUBLICATION VOLUME ISSUE PAGE

HOME MY SPRINGERLINK BROWSE TOOLS HELP SHOPPING CART LOG IN

- Related** | Issue | Journal
- View Related Documents**
- Journal Article  
Prey capture in *Clausocalanus furcatus* (Copepoda: Calanoida). The role of swimming behaviour Marco Uttieri
- Journal Article  
Fractal properties of number systems Wolfgang Müller
- Reference Work Entry  
Phyllite Ina Alterman
- Journal Article  
Fractal properties of simulated bed profiles in coarse-grained channels André Robert
- Journal Article  
Probing the structure of nanograined CuO powders Ana E. Bianchi

EARTH AND ENVIRONMENTAL SCIENCE

GEOLOGISCHE RUNDSCHAU  
Volume 85, Number 1, 3-11, DOI: 10.1007/BF00192054



ORIGINAL PAPER  
**Fractal properties of multi-order folding as a tool for exploration of low-grade banded iron ores in the Krivoy Rog basin (Ukraine)**

D. A. Kulik and M. I. Chernovsky

Download PDF (1.2 MB) View HTML Permissions & Reprints

REFERENCES (9) EXPORT CITATION ABOUT

**Abstract**

The low-grade Palaeoproterozoic stratabound banded iron ores of the Krivoy Rog basin (Ukraine) underwent strong tectonometamorphic deformation into superimposed folds of several orders, with amplitudes from centimetres to hundreds of metres. The across-strike sections of bed surfaces defining the low-grade ore bodies resemble self-similar fractal curves; hence, a fractal geometrical model was developed in order to quantify the complexity and sinuosity of bed contours. Two different methods of measurement (polygonal approximation and two-dimensional grid cell counting) were used for 5-8 different scales. Factual similarity dimension  $D$  and other model parameters have been estimated by means of linear regression and compared for both measurement methods. From the fractal model a sinuosity coefficient of contours of the folded bed surfaces  $K_s$  and a coefficient of degree of exploration of iron ore bodies  $K_e$  were constructed. It is pointed out that parameters of the model can be used for determination of the optimal exploration length scales.

**Key words** Fractal geometry - Iron ores - Banded iron formations - Prospecting and exploration - Structural geology

*Fulltext Preview*



Now available in Canada



D. A. Kulik · M. I. Chernovsky

**Fractal properties of multi-order folding as a tool for exploration of low-grade banded iron ores in the Krivoy Rog basin (Ukraine)**

Received: 30 June 1995 / Accepted: 24 November 1995

**Abstract** The low-grade Palaeoproterozoic strata-bound banded iron ores of the Krivoy Rog basin (Ukraine) underwent strong tectonometamorphic deformation into superimposed folds of several orders, with amplitudes from centimetres to hundreds of metres. The across-strike sections of bed surfaces defining the low-grade ore bodies resemble self-similar fractal curves; hence, a fractal geometrical model was developed in order to quantify the complexity and sinuosity of bed contours. Two different methods of measurement (polygonal approximation and two-dimensional grid cell counting) were used for 5–8 different scales. Fractal similarity dimension  $D$  and other model parameters have been estimated by means of linear regression and compared for both measurement methods. From the fractal model a sinuosity coefficient of contours of the folded bed surfaces  $K$ , and a coefficient of degree of exploration of iron ore bodies  $K_e$  were constructed. It is pointed out that parameters of the model can be used for determination of the optimal exploration length scales.

**Key words** Fractal geometry · Iron ores · Banded iron formations · Prospecting and exploration · Structural geology

**Introduction**

Early Precambrian basins of banded iron formation (BIF) contain approximately 80% of the world iron re-

sources. In particular, the Krivoy Rog basin, located in the central part of the Ukraine, has been intensively studied over 100 years because of mining of both the high-grade and low-grade iron ores. It is a narrow synclinalium extending up to 75 km in the submeridional direction, filled with metamorphic rocks of the Krivoy Rog Supergroup, folded and cut by several major submeridional thrusts (Fig. 1). The Lower Proterozoic Krivoy Rog Supergroup (series in Russian nomenclature) according to Belevtsev et al. 1983, and Kulik and Korzhnev 1995, is subdivided into five groups (suites):

1. New Krivoy Rog Group (metabasite units overlying quartzite and metasandstone horizons)
2. Skelevat Group (metaconglomerate, metasandstone, phyllite, talc-actinolite schist units)
3. Saxagan (iron ore) Group (alternations of up to seven pairs of BIF and ferruginous shist units)
4. Gdantsev Group (metamorphosed breccia of BIF rocks, metasandstone, black schist and dolomite marble units)
5. Gleevat Group (mainly metaconglomerate and metasandstone beds).

The total thickness of the Krivoy Rog Supergroup reaches 5–6 km, whereas that of the iron-ore Saksagan Group comprises up to 1400 m. Compared with other BIF basins of the same age (Hamersley in western Australia or Transvaal in South Africa), rocks of the Krivoy Rog Supergroup underwent stronger metamorphism, up to epidote-amphibolite facies (Belevtsev et al. 1983). The BIF rocks and ores of the Saksagan Group display typical multi-order banding (Fig. 2), most prominent on a mesoband (milli-metre/centimetre) scale, where it consists of packages (1 cm to 1 m thick) of quartz; Fe-oxide (magnetite, haematite); mixed quartz/Fe-oxide (or quartz/Fe-carbonate) mesobands, separated by the irregularly spaced "schist" (silicate) interbands containing chloritic, biotitic, stilpnomelane, albite, carbonate and pyrite in various proportions (Kulik 1991; Kulik and Korzhnev 1995). These interbands often show signs of shearing in the folded parts of the banded BIF rock.

D. A. Kulik (✉)  
Department of Metallogeny,  
State Scientific Centre for Environmental Radiogeochemistry,  
34 Palladin Pros. UA-252680 Kyiv, Ukraine  
Fax: +380-44-4441366  
E-mail: Kulik@metaldp.kiev.ua

M. I. Chernovsky  
Geological Department, Mining-Ore Deposit Institute,  
UA-324027 Krivoy Rog, Ukraine

**GeoComputing Group**

The premier consulting service for Landmark's suite of products  
[www.geocomputing.net](http://www.geocomputing.net)



Share this Item

email
 citeulike
 Connotea
 Delicious

Frequently asked questions | General info on journals and books | Send us your feedback | Impressum | Contact us  
© Springer, Part of Springer Science+Business Media | Privacy, Disclaimer, Terms & Conditions, and Copyright Info

NOT LOGGED IN  
RECOGNIZED AS: SWI-SCHWEIZ (169-04-496) GER MyCopy (493-61-543) PAUL SCHERRER INSTITUT (435-87-672) SWI-SCHWEIZ KAP 644738 (575-24-965)  
REMOTE ADDRESS: 192.33.126.163 SERVER: MPWEB25  
HTTP USER AGENT: MOZILLA/5.0 (MACINTOSH; U; INTEL MAC OS X 10\_6\_4; EN-US) APPLEWebKit/533.18.1 (KHTML, LIKE GECKO) VERSION/5.0.2 SAFARI/533.18.5