

Contents lists available at ScienceDirect

## Earth-Science Reviews

journal homepage: www.elsevier.com/locate/earscirev



# Paleogeography as geological heritage: Developing geosite classification



Delia Evelina Bruno <sup>a,b</sup>, Brooke E. Crowley <sup>c,d</sup>, Jaroslav M. Gutak <sup>e</sup>, Adriana Moroni <sup>f</sup>, Olesya V. Nazarenko <sup>g</sup>, Kathryn B. Oheim <sup>h</sup>, Dmitry A. Ruban <sup>b,i,j,\*</sup>, Günter Tiess <sup>b,k</sup>, Svetlana O. Zorina <sup>l,m</sup>

- <sup>a</sup> CNR-IRSA, National Research Council, Water Research Institute, Via F. Blasio 5, 70125 Bari, Italy
- <sup>b</sup> International Agency for Minerals Policy ("MinPol"), Austria
- <sup>c</sup> Department of Geology, University of Cincinnati, Cincinnati, OH 45221, USA
- <sup>d</sup> Department of Anthropology, University of Cincinnati, Cincinnati, OH 45221, USA
- e Division of Geology and Geodesy, Institute of Mining and Geosystems, Siberian State Industrial University, Kirov Street 42, Novokuznetsk, Kemerovo Region 654007, Russia
- f Research Unit of Prehistory and Anthropology, Department of Physical, Earth and Environmental Sciences, University of Siena, via Laterina, 8, 53100 Siena, Italy
- <sup>8</sup> Department of Physical Geography, Ecology, and Nature Protection, Institute of Earth Sciences, Southern Federal University, Zorge Street 40, Rostov-na-Donu 344090, Russia
- <sup>h</sup> Suffolk County Department of Planning, 4th Floor, 100 Veterans Memorial Highway, Hauppauge, NY 11788, USA
- i P.O. Box 7333, Rostov-na-Donu 344056, Russia 1
- <sup>j</sup> Department of Tourism, Higher School of Business, Southern Federal University, 23-ja linija Street 43, Rostov-na-Donu, 344019, Russia
- k Chair of Mining Engineering and Mineral Economics, Department of Mineral Resources and Petroleum Engineering, University of Leoben, Franz-Josef-Strasse 18, A-8700 Leoben, Austria
- <sup>1</sup> Central Research Institute of Geology of Industrial Minerals, Zinin Street 4, Kazan, Republic of Tatarstan 420097, Russia
- m Deparment of Palaeontology and Stratigraphy, Institute of Geology and Oil-Gas Technologies, Kazan Federal University, Kremljovskaja Street 4/5, Kazan, Republic of Tatarstan 420008, Russia

#### ARTICLE INFO

Article history: Received 4 October 2013 Accepted 21 June 2014 Available online 27 June 2014

Keywords:
Geological heritage
Paleogeographical geosite
Paleoecosystem
Paleoenvironment
Geodiversity
Geotourism

#### ABSTRACT

Geological heritage sites (geosites) are sites that contain information about the state and the dynamics of the Earth. Paleogeographical (paleoenvironmental) geosites preserve paleoenvironments, paleoecosystems, and other relevant phenomena. However, the value of these sites can only be fully understood through professional interpretation of the observed features. Description of paleogeographical geosites in terms of the paleospace and the geologic time they encompass is challenging, partially because of many uncertainties in the interpretations of a given geosite and in the paleogeographical, paleobiogeographical, and stratigraphical nomenclature. These geosites can be classified on the basis of facies, paleoecosystems, ichnological value, taphonomic patterns, major events and catastrophes, and geoarcheological potential that they exhibit. Some geosites comprise several subtypes, and some are especially important for construction of paleogeographical maps. Moreover, the paleogeographical geosite type always associates with other types of geosites (20 in total). These combinations form complex geosites that contribute to geodiversity. If information about the Earth's past is especially valuable for a given complex geosite, then the paleogeographical type is dominant.

© 2014 Elsevier B.V. All rights reserved.

### Contents

1.	Introduction	301
	Paleogeographical geosites: conceptual remarks	
3.	Towards classification of paleogeographical geosites	303
4.	Paleogeography in complex geosites	307
5.	Conclusions	308
Ackr	nowledgments	308
Refe	rences	309

<sup>\*</sup> Corresponding author at: Department of Tourism, Higher School of Business, Southern Federal University, 23-ja linija Street 43, Rostov-na-Donu, 344019, Russia. Tel.: +7 903 4634344.

E-mail addresses: delia.bruno@ba.irsa.cnr.it (D.E. Bruno), brooke.crowley@uc.edu (B.E. Crowley), GutakJaroslav@yandex.ru (J.M. Gutak), adriana.moroni@unisi.it (A. Moroni), olesyanv@yandex.ru (O.V. Nazarenko), graphicgranite@gmail.com (K.B. Oheim), ruban-d@mail.ru, ruban-d@rambler.ru (D.A. Ruban), guenter.tiess@unileoben.ac.at (G. Tiess), svzorina@yandex.ru (S.O. Zorina).

<sup>&</sup>lt;sup>1</sup> For postal communication.