

Source and Data source

Introduction

Source:

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Hundert Meisterwerke - Die schönsten Geotope Bayerns / Lagally U., Rohrmüller J., Glaser S., Loth G. & Purner // Bayerisches Landesamt für Umwelt (LfU), Augsburg 2. Auflage 2012. - 288 s.
Geomorphosites / Ed: Reynard E., Coratza P., Regolini-Bissig G./ Publ.: Verlag Dr. Friedrich Pfeil., 2009. - 240 p.
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V.Yu. Khalatov, S.N. Abdul'myanov. Geotopes of Mountain Territories: Definitions, Approacher to the Study, Protection / Geography and Natural Recourses, 2013, Vol. 34. No.1, pp. 14-19. Pleiades Publ.
<https://doi.org/10.1134/S1875372813010022>
Abdul'myanov S.N., Arifulov R.Ch. The concept of the information resource "Atlas of simple relief forms of Mongolia". Izvestiya Vuzov. Geodesy and Aerial Photography. 2022; 66(2): 62-80. DOI:10.30533/0536-101X-2022-66-2-62-80.

Data source:

Geotopen in Deutschland, "Nationale Geotope" Akademie für Geowissenschaften und Geotechnologien e.V., Hannover, Bundesministerium für Bildung und Forschung (BMBF) / <https://www.geoakademie.de/geotope>
European Association for the Conservation of the Geological Heritage (ProGeo) / <http://www.progeo.ngo>
European Geoparks Network (EGN) / <http://www.europeangeoparks.org>
GeoUnion Alfred Wegener Stiftung Programm "Nationale GeoParks in Deutschland" / <http://www.nationaler-geopark.de/startseite.html>
Global Geoparks Network, Global Network of National Geoparks (GGN) / <http://www.globalgeopark.org>
International Union of Geological Sciences (IUGS) / <https://iugs.org/index.php>
Asia Pacific Geoparks Network (APGN) / <https://asiapacificgeoparks.org/>
Keketuohai UNESCO Global Geopark / www.keketuohaigeopark.com/en
National Park Service (U.S. NPS) / <https://www.nps.gov/hfc/cfm/carto.cfm>
UNESCO World Heritage / <http://whc.unesco.org>
The First 100 IUGS Geological Heritage Sites. IUGS International Commission on Geoheritage, International Union of Geological Sciences (IUGS) / <https://iugs-geoheritage.org/>

Part 1. Endogenous processes and landforms: Tectonic deformations, earthquakes and magmatism

1.1. Tectonic shear deformations (seismic dislocations) / FAULT

Source:

Solonenko VP, Treskov AA, Florensov NA. Catastrophic Gobi-Altai earthquake on December 4, 1957. Seismogeological essay. Moscow: Gosgeoltekhizdat; 1960. 48 p.
Interpretation of multizone aerospace images. Methods and results. Ed. Sagdeev SZ, Salishchev KA, Kauzleben H. Moscow: Nauk; 1982. 82 p.
Agatova A.R., Nepop R.K., Ganyushkin D.A., Otgonbayar D., Griga S.A., Ovchinnikov I.Yu. Influence of the 1988 earthquake on glacierization and relief of the Tsambagarav massif (Western Mongolia). Ice and Snow. 2022, 62 (1): 17-34. - [In Russian]. <https://doi.org/10.31857/S2076673422010113>.
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Voskresensky A.G., Sankov V.A., Parfeevets A.V. Structure of seismogenic deformation in shear zones (Tsetserleg and Bolnay faults, North Mongolia) / Modern geodynamics of Central Asia and dangerous natural processes: results of research on a quantitative basis: Proceedings of the III All-Russian Society broadcasting and the II All-Russian Youth School on Modern Geodynamics (Irkutsk, September 19-23, 2016). - Irkutsk: Institute of the Earth's Crust SB RAS, 2016. pp. 76-78. - [In Russian].
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Ovsyuchenko A.N., Butanaev Yu.V. Seismic history of the Altai-Sayan region and the 2011-2012 earthquakes in Tuva / New Research of Tuva, pp. 163-181. - [In Russian].
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Data source:

Mongolian People's Republic. National Atlas / Ch. ed: V.V. Vorobyov, Sh. Tsegmid / Ulaanbaatar - Moscow. 1990. - 144 p. - [In Russian].
One Century of Seismicity in Mongolia. Scale 1:2 500 000, Adiya M, Ankhtsetseg D, Baasanbat T, Bayar G, Bayarsaikhan C, Erdenezul D, Mungunsuren D, Munkhsaikhan A, Munkhuu D, Narantsetseg R, Odonbaatar C, Selenge L, Tsembe D, Ulziibat M., Urtnasan K., Coordinators: Dugarmaa, T. Schlupp, A. // Publ. Journal Research Center of Astronomy and Geophysics, Mongolian Academy of Science et Departement Analyse Surveillance Environnement, CEA-France (RCAG-DASE), 2003, – 1 sheet
ArcGIS Online Viewer, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>
Consortium for Spatial Information of the Consultative Group for International Agricultural Research (CGIAR-CSI). <http://srtm.csi.cgiar.org>
Geological Institute of the Russian Academy of Sciences, Laboratory of neotectonics and recent geodynamics, Active Faults of Eurasia Database (AFEAD), version 2022 / http://neotec.ginras.ru/index/english/database_eng.html
Global Earthquake Model (GEM) Global Earthquake Model Foundation / <https://www.globalquakemodel.org/openquake>
Global Historical Earthquake Archive (GHEA) / <https://www.emidius.eu/GEH/map.php>
Global Seismic Hazard Assessment Program (GSHAP) / <http://www.seismo.ethz.ch>
USGS Advanced National Seismic System (ANSS) / <http://earthquake.usgs.gov/monitoring/anss/>

1.2. Tectonic folded deformations (plastic deformations – layers and folds) / FOLD

Source:

A.K. Korsakov, A.D. Mezhelovsky, S.V. Mezhelovskaya, N.A. Pogrebs, A.N. Zhuravlev, A.M. Lapteva, A.K. Naravas, M.I. Nikitina, N.V. Pavlinova, A.A. Ryzhova, S.A. Sokolov, L.K. Filatova, A.D. Chernova / Laboratory work on structural geology. Ed A.K. Korsakov A.K. - M.: (MGRI-RGGRU) 2016. - 213s. - [In Russian].
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Data source:

ArcGIS Online Viewer, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>
Consortium for Spatial Information of the Consultative Group for International Agricultural Research (CGIAR-CSI). <http://srtm.csi.cgiar.org>
U.S. Geological Survey, Earth Resources Observation & Science Center (EROS). <https://landsatlook.usgs.gov/viewer.html>

1.3. Magmatic and volcanic structures (intrusive and effusive magmatism) / MAGMA

Source:

Genshaft Yu.S., Saltykovsky A.Ya. Cenozoic volcanism in Mongolia / *Russian Journal of Earth Sciences*. Volume 2, no. 3/4, February 2000, - pp. 153-183. - [In Russian].
Geological formations of Mongolia / Ed. Col.: Barsbolt R., Luvsandanzan B., Knipper A.L., Yanshin A.L., Kovalenko V.I., Dergunov A.B., Nagibina M.S., Ruzhentsev S.V., Yarmolyuk V.V., Gerbova V.G. / Rev.: A.B. Lergunov, V.I. Kovalenko / Trudy sovm. ros mong. scientific research geol. expeditions, vol. 55. - M.: Publ. "Step", 1995, - 177. - [In Russian].
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Selivanov E.I. Neotectonics and geomorphology of the Mongolian Folk Republics / - M.: "Nedra". 1972. - 296 p. from ill. and maps. - [In Russian].
Chuvashova I.S., Rasskazov S.V., Yasnygina T.A., Mikheeva E.A., 2012. High-Mg lavas from the Dariganga volcanic field in the South-Eastern Mongolia: petrogenetic model of magmatism at the asthenosphere-lithosphere boundary. *Geodynamics & Tectonophysics* 3 (4), 385-407. doi:10.5800/GT-2 012-3-4-0081. (Institute of the Earth's Crust, Siberian Branch of RAS, Irkutsk, Russia).

Data source:

ArcGIS Online Viewer, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>
Consortium for Spatial Information of the Consultative Group for International Agricultural Research (CGIAR-CSI). <http://srtm.csi.cgiar.org>
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Part 2. Exogenous processes and landforms. External processes and their morphological manifestations.

2.1. Meteorite craters (astroblemes) / ASTROBLEMES

Source:

Meteorites from Mongolia

Bischoff A., Gerel O., Buchwald V.F. et al. Meteorites from Mongolia. *Meteoritics and Planetary Science*. 1996; 31(1): pp. 152-157. DOI:10.1111/j.1945-5100.1996.tb02063.x.
Gerel O., Bischoff A., Schultz L. et al. The 1993 EUROMET. Mongolian Expedition to the Gobi Desert: Search for Meteorites. Workshop on "Meteorites from Cold and Hot Deserts". L.Schultz, J.O. Annexstad, M.E. Zolensky (eds.). LPI Tech. Rpt. 1995; 95-02: pp. 32-33.

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Geological formations of Mongolia. Proceedings of the Council. Russian-Mong. Scientific Geol. Expeditions. A.B.Lergunov, V.I.Kovalenko (eds.). 1995; 55. Moscow, 1995. - [In Russian].

Meteorite crater in Mongolia

Tabun-Khara-Obo

Suetenko O.D., Shkerin L.M. A supposed meteorite crater in southeastern Mongolia. *Astronomical Bulletin*. 1970; 4: pp. 261-263. DOI:10.13140/RG.2.2.17623.68003. - [In Russian].

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Tsenkher

Komatsu G., Olsen J.W., Ormo J., Achille G.Di. The Tsenkher structure in the Gobi-Altai, Mongolia: geomorphological hints of an impact origin. *Geomorphology*. 2006; 74(1-4): pp. 164-180. DOI:10.1016/j.geomorph.2005.07.031.

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Dorjnamjaa D., Voinkov D.M., Kondratov L.S. et al. Concerning diamond and gold-bearing astropipes of Mongolia. *International J. of Astronomy and Astrophysics (IJAA)*. 2011; 11: pp. 98-104. DOI:10.4236/ijaa.2011.12014.

Dorjnamjaa D., Altanshagai G. A new scientific discovery of the unique gold and diamond-bearing Agit Khangay and Khuree Mandal Astropipes of Mongolia. *International Journal of Modern Research in Engineering and Technology (IJMRET)*. 2018; 3(1): pp. 62-67.

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Abdul'myanov S.N. Ring Structures of Mongolia: Features, Directions of Modern Research, and Geotourism / *Nature* 12, 2022. pp. 17-28. DOI:10.7868/S0032874X2212002X - [In Russian].

Data source:

ArcGIS Online Viewer, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>

Consortium for Spatial Information of the Consultative Group for International Agricultural Research (CGIAR-CSI). <http://srtm.csi.cgiar.org>

U.S. Geological Survey, Earth Resources Observation & Science Center (EROS). <https://landsatlook.usgs.gov/viewer.html>

Meteoritics and Planetary Science (MaPS), Meteoritical Society, Meteoritical Bulletin and the Meteoritical Bulletin Database (MBDB) / <https://www.lpi.usra.edu/meteor/metbull.php>

Earth Impact Database (EIDB), The Planetary and Space Science Centre (PASSC), Department of Earth Sciences, University of New Brunswick (UNB) / www.passc.net/EarthImpactDatabase/

Catalogue of the Earth's Impact structures (EISC), Mikheeva A.V. / <http://labmpg.sccc.ru/>;

Expert Database on Earth Impact Structures (EDEIS), Institute of Computational Mathematics and Mathematical Geophysics SB RA, Tsunami Laboratory / <http://tsun.sccc.ru/nh/impact.php>

Institute of Geology and Mineral Recourse, Institute of Astronomy and Geophysics, Mongolian Academic of the Sciences / <http://en.ac.mn/>; www.igmr.mas.ac.mn/; <https://iag.mn/en/index.php>

2.2. Glacial and permafrost landforms (snow, ice and soil) / CRYOGENIC SHAPE

Source:

Geocryological conditions of the Mongolian People's Republic / Ed: Melnikov P.I. // Joint. Sov.-Mongolian scientific-iss. geol. expedition. Issue. 10. M.: Nauka, 1974. 208 p. - [In Russian].

Obu J., Westermann S., Bartsch A., Berdnikov N., Christiansen Hanne H., Dashtseren A., Delaloye R., Bo Elberling, Etzelmuller B., Kholodov A., Khomutov A., Kääb A., Leibman M.O., Lewkowicz Antoni G., Panda Santosh K., Romanovsky V., Robert G. Way, Westergaard-Nielsen A., Wu T., Yamkhin J., Zou D / Northern Hemisphere permafrost map based on TTOP modelling for 2000–2016 at 1 km 2 scale / Elsevier, *Earth-Science Reviews*, 193 (2019). pp. 299-316.

Ganyushkin D.A. Glaciogenic complexes of the sharply continental region of the north-west of Inner Asia / dissertation ... Doctor of Geography: 25.00.23 - Physical geography and biogeography, soil geography and landscape geochemistry / Ganyushkin Dmitry Anatolyevich / - St. Petersburg, 2016. 430 p. - [In Russian].

The Physical Geography of Mongolia (2021), Ed. Batchuluun Yembuu / Springer Nature Switzerland AG 2021. 218 p. - (Geography of the Physical Environment).

Kamp U., Krumwiede B., McManigal K., Pan C., Walther M., Dashtseren A. (2013) The Glaciers of Mongolia / Institute of Arctic and Alpine Research University of Colorado, Occasional Paper No. 61.

Lehmkuhl, F., Stauch G., Batkhishing, O. (2003). Rock glacier and periglacial processes in the Mongolian Altai // Permafrost, Phillips, Springman & Arenson (eds). Swets & Zeitinger, Lisse. pp. 639-644.

Data source:

ArcGIS Online Viewer, ArcGIS Living Atlas of the World, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>
Global Land Ice Measurements from Space (GLIMS). Monitoring the World's Changing Glaciers, GLIMS Glacier Database, GLIMS Glacier Viewer / <https://www.glims.org/maps/glims>
U.S. Geological Survey, Earth Resources Observation & Science Center (EROS). <https://landsatlook.usgs.gov/viewer.html>
Topographic map. Military topographic department of the General Staff of the Armed Forces of the USSR. - 1976. Ed. 1982. Sheets M 45-84, M 45-75, M 45-87, M 45-132, M 45-144.

2.3. Fluvial landforms (rivers and valleys, slopes, streams and lakes) / HYDROGENIC SHAPE

Source:

Miller V., Miller K. Aerial photography: per. from English. / Ed: G.F. Lungershausen. M.: MIR. 1964. 292 p. - [In Russian].
Selivanov E.I. Neotectonics and geomorphology of the Mongolian People's Republic. M.: Nedra. 1972. 296 p. - [In Russian].
Bierman P.R., Montgomery D.R. Key Concepts in Geomorphology. New York: W.H. Freeman and Company Publishers: A Macmillan Higher Education Company. 2014. 530 p.
Goudie A.S. Arid and semi-arid geomorphology. Cambridge: Cambridge University Press. 2013. 468 p.
Geocryological conditions of the Mongolian People's Republic / Ed: Melnikov P.I. // Joint. Sov.-Mongolian scientific-iss. geol. expedition. Issue. 10. M.: Nauka, 1974. 208 p. - [In Russian].
The Physical Geography of Mongolia (2021), Ed. Batchuluun Yembuu / Springer Nature Switzerland AG 2021. 218 p. - (Geography of the Physical Environment).
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Orkhonselenge A., Uuganzaya M., Davaagatan T. Lakes of Mongolia. Geomorphology, Geochemistry and Paleoclimatology / Alexander Orkhonselenge, Munkhjargal Uuganzaya, Tuyagerel Davaagatan. / The Ed. Springer Nature Switzerland AG 2022 452 p. (Syntheses in Limnogeology).

Data source:

ArcGIS Online Viewer, ArcGIS Living Atlas of the World, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>
U.S. Geological Survey, Earth Resources Observation & Science Center (EROS). <https://landsatlook.usgs.gov/viewer.html>
Topographic map. Military topographic department of the General Staff of the Armed Forces of the USSR. - 1976. Ed. 1982.

2.4. Aeolian landforms (areas of sandy massifs) / AEOLIAN SHAPE

Source:

Climates of the arid zone of Asia. Ed. Vostokova EA, Gunin P.D. Biological resources and natural conditions of Mongolia: Proceedings of the Russian and Mongolian complex biological expedition. Moscow: Nauka; 2006. Vol. 46. 359 p.
The Physical Geography of Mongolia (2021), Ed. Batchuluun Yembuu / Springer Nature Switzerland AG. 2021. 218 p. - (Geography of the Physical Environment).
Goudie, A. Arid and semi-arid geomorphology (2013) / Andrew Goudie / First publ. University of Oxford. - 2013. 454 p. - (Cambridge University Press).

Data source:

ArcGIS Online Viewer, ArcGIS Living Atlas of the World, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>
U.S. Geological Survey, Earth Resources Observation & Science Center (EROS). <https://landsatlook.usgs.gov/viewer.html>
Ecosystems of Mongolia Atlas / Exp. Ed. P.D. Gunin, M. Saandar, Moscow-Ulaanbaatar // Institute of Ecology and Evolution A.N. Severtsova of the Joint Russian-Mongolian Complex Biological Expedition RAS and MAS. Publ. ADMON Print. 2019. - 264 p.
Tserendash S., Sanjmyatav D. Hayfield and Pastural land map of Mongolia / Scale 1:2,000 000, Institute of Animal Husbandry, WWF Mongolia, Ulaanbaatar, - 2010, - 1 sheet.

2.5. Human and relief / TECHNOGENIC SHAPE

Source:

Geological map of Mongolia. Scale 1:1,000,000. Ed. O. Tamurtogoo. Institute Geology and Mineral Resources, Academy of Sciences of the Mongolia (MAS), Geological Information Center of MRAM. Ulaanbaatar. 2002. - 14 sheets.
Mineral Deposits and Occurrences of Mongolia, Scale 1:1,000,000. Ed. Battogtocht Enkhtuya. Institute Geology and Mineral Resources, Academy of Sciences of the Mongolia (MAS), Geological Information Center of MRAM. Ulaanbaatar. 2001. - 14 sheets.

Data source:

ArcGIS Online Viewer, ArcGIS Living Atlas of the World, Esri Inc. <https://www.arcgis.com/home/webmap/viewer.html>
Mineral Resources, Online Spatial Data: Interactive maps and downloadable data for regional and global Geology, Geochemistry, Geophysics, and Mineral Resources, USGS / <https://mrdata.usgs.gov/general/map-global.html>
MonGeoCat, Mineral Resources and Petroleum authority of Mongolia (MRPAM) / www.mrpam.gov.mn / <http://webgis.mris.mn/>