Stress Map of Great Britain and Ireland 2022

Editors: Andrew Kingdon[1], John Williams[1], Mark Fellgett[1], Naomi Rettelbach[2,3], Oliver Heidbach[3]

[1] British Geological Survey, [2] Institute of Geosciences, University of Potsdam, Germany
[3] Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences

Knowledge of the present-day crustal stress field is a key for the understanding of geodynamic processes such as global plate tectonics and earthquakes. It is also essential for the management of geo-reservoirs and underground storage sites. Since 1986, the World Stress Map (WSM) project has systematically compiled the orientation of maximum horizontal stress (S_{Hmax}). It is a collaborative project between academia and industry that aims to characterize the stress pattern and to understand the stress sources and it is maintained at the GFZ German Research Centre for Geosciences. All stress information is analysed and compiled in a standardized format and quality-ranked for reliability and comparability on a global scale. Further information on the WSM project, its services and software are available on the project website at http://www.world-stress-map.org. The stress map of Great Britain and Ireland 2022 is based on the WSM database release 2016. All data records have been checked and we added a number of new data from earthquake focal mechanisms from the national earthquake catalog and borehole data. The number of data records has increased from n=377 in the WSM 2016 to n=474 in this map. Some locations and assigned quality of WSM 2016 data were corrected due to new information. The digital version of the map is a layered pdf generated with GMT (Wessel et al., 2019) using the topography of Tozer et al. (2019). We also provide on a regular 0.1° grid values of the mean S_{Hmax} orientation which have a standard deviation < 25°. The mean S_{Hmax} orientation is estimated using the tool stress2grid of Ziegler and Heidbach (2019). For this estimation we used only data records with A-C quality and applied weights according to data quality and distance to the grid points. The stress map is available at the landing page of the GFZ Data Service at http://doi.org/10.5880/WSM.GreatBritainIreland2022 where further information is provided.

Stress map displays the orientation of maximum horizontal compressional stress S_{Hmax}

Method

focal mechanism
borehole breakouts
drill. induced frac.
overcoring
hydro. fractures
geol. indicators

Data depth range

0-40 km

WSM WORLD STRESS MAP

Quality

A	———	S_{Hmax} is within ± 15°
B	———	S_{Hmax} is within ± 20°
C	———	S_{Hmax} is within ± 25°
D	—	S_{Hmax} is within ± 40°
E	•	no reliable information

Stress Regime

- Normal faulting
- Strike-slip faulting
- Thrust faulting
- Unknown regime

normal faulting regime
$S_V > S_{Hmax} > S_{hmin}$

strike-slip regime
$S_{Hmax} > S_V > S_{hmin}$

thrust faulting regime
$S_{Hmax} > S_{hmin} > S_V$

Key references

Heidbach, O., Rajabi, M., Cui, X., Fuchs, K., Müller, B., Reinecker, J., Reiter, K., Tingay, M., Wenzel, F., Xie, F., Ziegler, M.O., Zoback, M.-L. and Zoback, M.D. (2018): The World Stress Map database release 2016: Crustal stress pattern across scales. Tectonophysics, 744, 484-498, http://doi.org/10.1016/j.tecto.2018.07.007

Kingdon, A., M. W. Fellgett, and D. O. Williams (2016): Use of borehole imaging to improve understanding of the in-situ stress orientation of Central and Northern England and its implications for unconventional hydrocarbon resources. Marine and Petr. Geol., 73, 1-20, http://doi.org/10.1016/j.marpetgeo.2016.02.012

Tozer, B., D. T. Sandwell, W. H. F. Smith, C. Olson, J. R. Beale, and P. Wessel (2019): Global Bathymetry and Topography at 15 Arc Sec: SRTM15+. Earth and Space Science, 6(10), 1847-1864, http://doi.org/10.1029/2019ea000658

Wessel, P., Luis, J. F., Uieda, L., Scharroo, R., Wobbe, F., Smith, W. H. F., & Tian, D. (2019): The Generic Mapping Tools version 6. Geochemistry, Geophysics, Geosystems, 20, 5556–5564. https://doi.org/10.1029/2019GC008515

Williams, J. D. O., M. W. Fellgett, A. Kingdon, and J. P. Williamson (2015): In-situ stress orienation in the UK Southern North Sea: Regional trends, deviations and detachment of the post-Zechstein stress field. Marine and Petr. Geol., 67, 769-784, http://doi.org/10.1016/j.marpetgeo.2015.06.008

Ziegler, M. O. and Heidbach, O. (2019): Manual of the Matlab script Stress2Grid v1.1. WSM Technical Report 19-02, GFZ German Research Centre for Geosciences, http://doi.org/10.2312/wsm.2019.002

Citation of this map

Kingdon, A, Williams, J., Fellgett, M., Rettelbach, N., Heidbach, O. (2022): Stress Map of Great Britain and Ireland 2022, GFZ Data Services, http://doi.org/10.5880/WSM.GreatBritainIreland2022