Digimap for Schools

Tectonic Plates Overlay

User Guide

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Introduction

Plate tectonics delineate how the Earth's crust is divided into 52 large rocky plates that cover the globe like a jigsaw. Tectonic plates lie on top of a partially molten layer of rock which cause the plates to move around at different rates, from 2 to 15 centimetres per year (National Geographic Society, 2021a). Where these tectonic plates interact at plate boundaries, the energy released can cause phenomena such as mountain building events, volcanoes, and earthquakes (National Geographic Society, 2021a).

1.2 Tectonic Plates

There are 14 large tectonic plates:

- Africa
- Antarctica
- Arabia
- Australia
- Caribbean
- Cocos
- Eurasia
- India
- Juan de Fuca
- Nazca
- North America
- Pacific
- Philippine Sea
- South America

On top of these the model PB2002 from Bird (2003), includes 38 smallplates:

- Okhotsk
- Amur
- Yangtze
- Okinawa
- Sunda
- Burma
- Molucca Sea
- Banda Sea
- Timor
- Birds Head
- Maoke
- Caroline
- Mariana
- North Bismarck
- Manus
- South Bismarck

- Solomon Sea
- Woodlark
- New Hebrides
- Conway Reef
- Balmoral Reef
- Futuna
- Niuafo'ou
- Tonga
- Kermadec
- Rivera
- Galapagos
- Easter
- Juan Fernandez
- Panama
- North Andes
- Altiplano
- Shetland
- Scotia
- Sandwich
- Aegean Sea
- Anatolia
- Somalia

These are included in the model for a total of 52 plates (Bird, 2003:1).

1.3 Boundary Interactions

EDINA's plate tectonics product is derived from data used in the report "An updated digital model of plate boundaries" by Bird, 2003. The originaldigital model of plate boundaries from Bird (2003) classified plate boundary interactions into one of 7 types (continental convergence zone,continental transform fault, continental rift, oceanic spreading ridge, oceanic transform fault, oceanic convergent boundary, subduction zone). However, this has been simplified into just 4 types for the EDINA product: convergent, divergent, transform and subduction.

The 4 types of plate boundary in the tectonic plate overlay are defined bythe motion of the plates in relation to each other. Sections of Earth's crustcan come together and collide (a "convergent" plate boundary), spread apart (a "divergent" plate boundary) as seen in the East African Rift, or slide past one another (a "transform" plate boundary) such as the San Andreas Fault (National Geographic Society, 2021b). A single tectonic plate can have multiple types of plate boundaries with the other plates that surround it. For instance, the Pacific Plate, one of Earth's largest tectonic plates, includes convergent, divergent, and transform plate boundaries. A convergent plate boundary forms mountain ranges like theHimalayas as the Earth's crust is crumpled and pushed upward. In some cases, however, a convergent plate boundary can result in one tectonic plate diving underneath another (National Geographic Society, 2021b).

This process, called “subduction,” involves an older, denser tectonic platebeing forced underneath a younger, less-dense tectonic plate. When subduction occurs, a chain of volcanoes often develops near the convergent plate boundary, because molten rock from the Earth’s core, magma, can travel upward at these intersections between plates such as along the West coast of the US (National Geographic Society, 2021b).
Furthermore, when Earth’s tectonic plates grind past one another, enormous amounts of energy can be released in the form of earthquakes.

Data

The integrated dataset was built such that it provided a comprehensive and large-scale overview of tectonic plates, classified by boundary interaction. All the original data were retrieved as a shapefile from Bird, (2002). Data manipulation was performed in QGIS 3.16. The native data ispresented in vector format and projected in Geographic Coordinate System WGS 84. Prior to retrieval, the data had been edited within ArcGIS 10.2 which involved manually moving and splitting the segmentsspanning the -180/180 boundary.

Creation

The layer was loaded into QGIS and styled by applying a categorised symbology to the different types of plate boundary interactions and eachtectonic plate. Appropriate colours were chosen to allow for enough differentiation between plates and boundary types and to cater for colourvision deficiency.

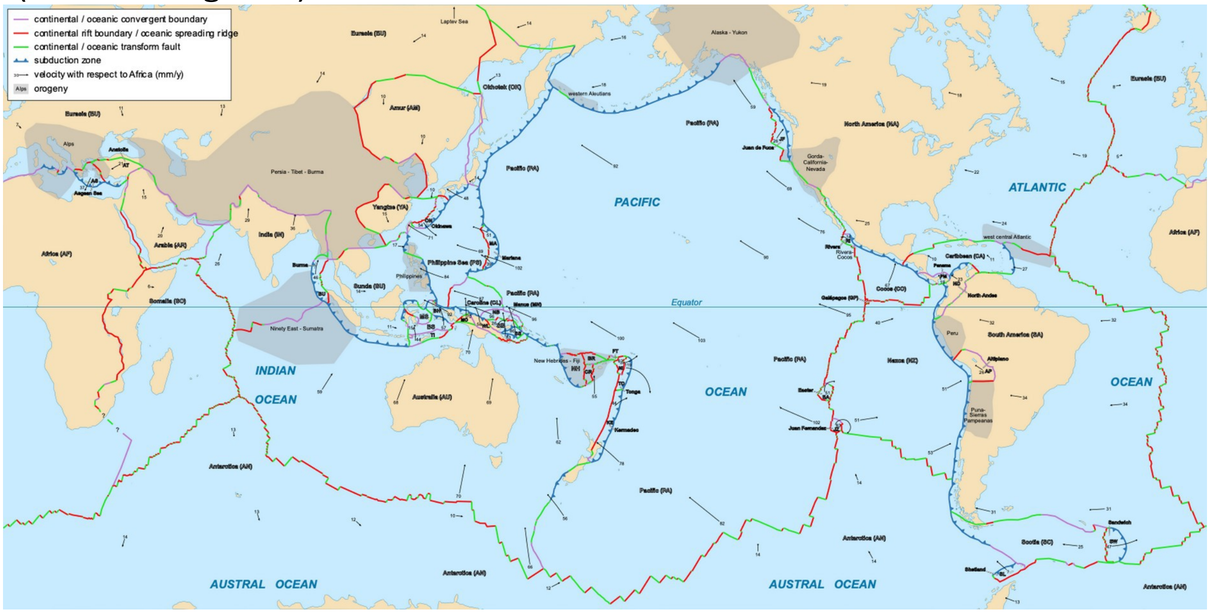
The dataset previously just consisted of one classification: subduction, andthe main change to the original data was the addition of other types of plate boundary interactions: convergent, divergent and transform boundaries. In cases where more than one type of tectonic plate interaction occurs on the boundary between two plates, the predominantone was selected and added to the dataset.

Tectonic plate boundary classifications were derived from a map oftectonic plates by Gaba, 2018.

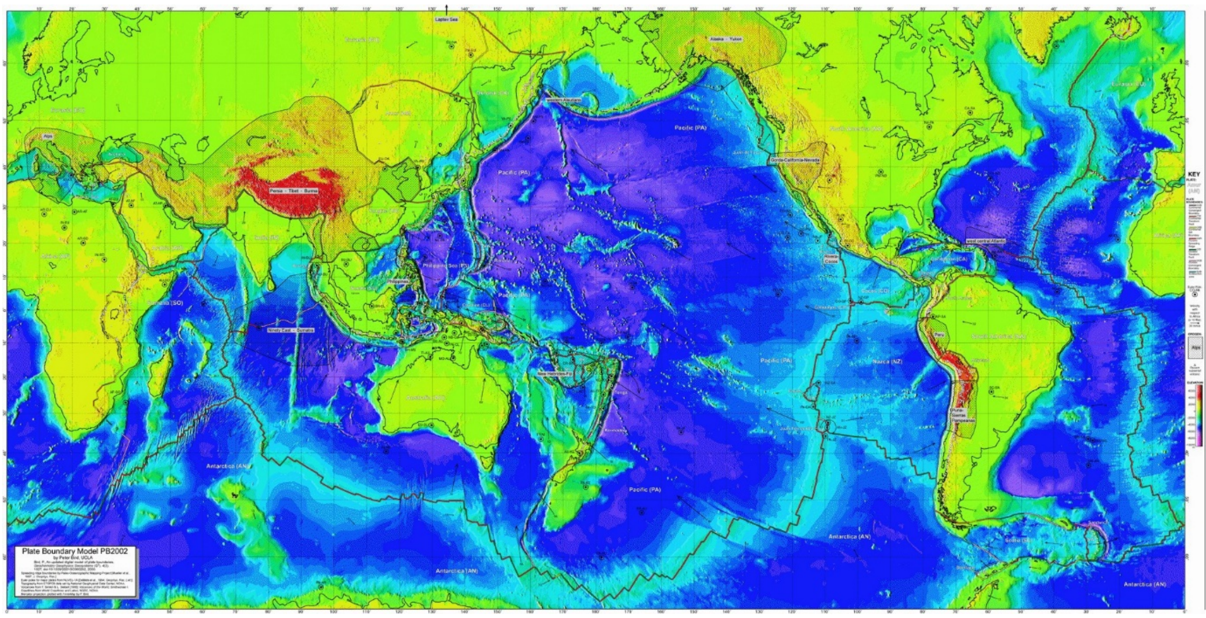
Figures

Figure 1: A detailed world map in English showing the tectonic plates withtheir movement vectors. (Gaba, 2018).

Figure 1 is an adapted and slightly simplified version of the diagram used in Peter Bird’s report ‘An updated digital model of plate boundaries’(Bird, 2003) (as seen in Figure 2):



Therefore, the different classifications of plate boundary interactionsoriginated from Bird, 2003, the same report as the rest of the data.



Usage

The products are appropriate for a wide range of uses such as academic research, teaching and reuse for non-profit activities. The global view enables comparisons to other overlays such as the volcanoes overlay, allowing for users to infer correlation. These products can be linked towider education on topics such as geophysics, and natural hazards suchas earthquake, volcano and tsunami events.

Plate models are only an approximation, and it should be understood thatthey are not entirely accurate, and there are areas where there is still some uncertainty regarding the exact positioning of tectonic boundaries.

No attempt is made to divide the Alps-Persia-Tibet mountain belt, thePhilippine Islands, the Peruvian Andes, the Sierras Pampeanas, or the California-Nevada zone ofdextral transtension into plates; instead, the original data source designated these areas as ‘‘orogens’’, complex regions, characterised bytruly distributed deformation such as topographic roughening or mountain-formation, in which this plate model is not expected to be accurate (Bird, 2003:2). The orogens layer was removed in the final product in order to simplify the overlay, however this increases the potential for users to incorrectly infer elevated seismic hazard at the boundaries of the orogens (Bird, 2003:2).

Conclusion

This guide provides an explanatory overview of the tectonic plate products in Digimap for Schools, the map creation process, and its potential uses. The scope of the dataset allowed for a detailed global tectonic plate layer to be produced, with the interactions between each plate classified. This overlayaims to increase understanding of the different types of tectonic plate interactions. The original data has been parsed, cleaned and verified usingArcGIS 10.2 and converted to shape files. The dataset presents tectonic plates and their boundaries, and information about the boundaries. The data is useful for geological applications, analysis and education.

Licence

References:

Ang, C., 2021. 1 Billion Years of Tectonic Plate Movement in 40 Seconds. [online] Visual Capitalist. Available at: https://www.visualcapitalist.com/1-billion-years-of-tectonic-plate-movement/ [Accessed 29 July 2021].

Bird, P., 2003. An updated digital model of plate boundaries,Geochemistry, Geophysics, Geosystems: 4(3), 1027, doi:10.1029/2001GC000252, 2003

Bird, P (2002). Electronic Data Submission for Paper 2001GC000252. Anupdated digital model of plate boundaries. Available at: http://peterbird.name/oldFTP/PB2002/ [Accessed 29 July 2021].

Gaba, E (2018). A detailed world map in English showing the tectonic plates with their movement vectors. [online] Available at: https://commons.wikimedia.org/wiki/File:Tectonic_plates_boundaries_detailed-en.svg#file [Accessed 29 July 2021].

National Geographic Society, 2021a. Plate Tectonics. [online] National Geographic Society. Available at: https://www.nationalgeographic.org/encyclopedia/plate-tectonics/ [Accessed 29 July 2021].

National Geographic Society, 2021b. Plate Boundaries. [online] National Geographic Society. Available at: https://www.nationalgeographic.org/encyclopedia/plate-boundaries/?utm_source=BibblioRCM_Row [Accessed 29 July 2021].