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Plate tectonic models derived from multiple data sources: Examples from the Arctic

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Plate tectonic reconstructions are a useful tool in the modern exploration industry. A variety of interpretative applications and data sets require robust plate models; specific examples include the rotation of well data to their past locations, analysis of palaeogeographic environments and predictions of properties such as heat flux through time. As plate tectonic reconstructions become more widely used they become more ambitious, pushing further back in time and including older stratigraphic units, often with increasingly complex tectonic histories. Geological data becomes increasingly sparse for these older units, leading to more subjective choices when creating plate models. In our global plate tectonic model we collate data from numerous sources, including geological structure mapping, interpretation and analysis of potential field data and depth to basement maps, palaeomagnetism and geological relationships from published literature. The plate model is strongly interlinked with on-going global studies at Getech, such as palaeoenvironment mapping, palaeotopography and palaeoclimate; direct feedback from these studies is used to refine and test tectonic solutions both within a regional and global framework.

Our global plate model is currently undergoing major improvements extending it back to the start of the Permian (300 Ma). This includes updates to oceanic structures and ocean-continent boundaries to better constrain the internal boundaries and fit of the Pangaea supercontinent. The update also includes Permian-Triassic modelling of South East Asia and China, improvements in Kazakhstan, Central Asia and the North American Cordillera and a re-evaluation of our existing Arctic tectonics. These regions also contain feedback from Jurassic palaeoenvironment mapping to improve the current tectonic reconstructions.

We present the multi-disciplinary approach to plate modelling with particular focus on North America and the Arctic. Numerous and often conflicting hypotheses exist for the formation of the North American Cordillera; including the accretion of a series of allochthonous and parautochthonous terranes to ancestral North America in a prolonged orogeny, the formation of a ribbon continent in the Panthalassa Ocean which eventually accreted to North America or the accretion of two superterranes migrating northwards from significantly south of their present day position. To some degree, Russian Arctic tectonics mirrors the North American counterpart, with the Arctic Alaska and Chukotka terranes thought to be of similar or contiguous origin. The Verkhoyansk fold and thrust belt is formed during the collision of a micro-continent with the Siberian Craton and a series of arcs and back arcs accrete on the Pacific side of the craton. We demonstrate the construction of the plate model using the techniques described above to assess the validity of hypotheses and the origin of exotic Arctic terranes.