From the equatorial Atlantic to the Laptev Sea: the role of tectonic inheritance in the continental breakup and evolution of the Atlantic and Arctic oceans

BRIDGET E. ADY

GeoArctic Ltd., Calgary, Alberta T2P 2V7, Canada

In the more than fifty years since J. Tuzo Wilson posed the question, 'Did the Atlantic close and then reopen?', we have come to understand that the continents preserve the tectonic record of multiple superimposed Wilson cycles. From the Central Atlantic to the Arctic, structural lineaments from Proterozoic and Paleozoic orogenies record the closing of earlier oceans. What influence did these inherited orogenic structures exert on the tectonic evolution of the present day North Atlantic and Arctic margins? By quantitatively restoring Mesozoic–Cenozoic extension of up to several hundred km on some hyperextended parts of the Atlantic and Arctic margins, we show that a palinspastic deformable margin plate kinematic model is a valuable analytical tool when applied to the evaluation of the role of pre-existing structures in continental breakup. This includes examination of the evolution and orientation of rifting events, the reactivation of sutures and thrust fronts, the interplay between sutures of various ages, and the activation of major transforms from pre-existing sutures. Prerift restoration of the Proterozoic and Paleozoic terranes and structural lineaments on the conjugate margins aids in the analysis of their relationship to evolving rift axes and global plate reorganization events.

The present-day Guyana–Suriname to Senegal–Mauritania conjugate margins are separated from the Laptev Shelf in the eastern Arctic by the ca. 10 000 km north-south expanse of the Central and North Atlantic oceans and the Eurasia Basin of the Arctic Ocean. Continental breakup started in the Jurassic with the opening of the Central Atlantic and by the Eocene had propagated northwards to the Eurasia Basin. Our palinspastic deformable margin plate reconstruction of the region restores the history of the crustal deformation and multiple rifting episodes, with retro-deformed beta and crustal thickness maps charting the evolution of the rifted and hyperextended basins of the Atlantic and Arctic. Advances in deformable plate reconstruction methods provide us with accurately restored pre-breakup margin geometry, more detailed restored and reconstructed basement and structure maps, and the history of lateral strain and crustal thinning across these margins. Interpretation of these modelling results has led to a clearer understanding of the relationship between inherited structural features and their control on rifting, breakup history, and basin development.

Atlantic Geology, 2018, Volume 54
Conjugate Margins Conference 2018, August 19-22, 2018
doi: 10.4138/atlgeol.2018.014