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Impact of the South Atlantic opening on global and regional climate during Aptian and Albian times

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The South Atlantic ocean was initiated with a rifting phase during the Cretaceous: the Austral segment until the Walvis-Rio Grande Fracture zone opening during the upper Jurassic and lower Cretaceous, and the Central segment, from the Walvis-Rio Grande ridge to Ascension Fracture zone opening during Aptian. The latter is characterized by the presence of a thick salt layer (Brice et al., 1982; Brognon et Verrier, 1996), distinctive of an arid climate. During the connexion between the North and the South Atlantic during Albian times, a wet climatic belt occurs north of the Central segment (Chumakov et al., 1995). What does the occurring of this belt mean? What is the impact of the South Atlantic opening on climatic changes? What are the consequences on the sedimentary deposits?

In order to integrate climatic controls in sedimentary record of this section of the South Atlantic, we used an Earth system model called FOAM (for Fast Ocean Atmopshere Model) allowing to integrate and to simulate the consequences of the South Atlantic ocean opening. Three continental configurations were used: Lower and Upper Aptian, and Albian, according to palaeogeography of Sewall et al., 2007. Elevation of Andes and paleoshorelines were modified for the american and african cratons. Owing to the existing uncertainties about the elevation of the rift, we tested 1000m and 3000m of rift shoulders. The atmospheric CO_2 concentration was kept constant for the three experiments, and set at 1120ppm.

On a global scale, contrary to the evolution of the climatic zonation suggested by Chumakov et al., 1995, we found that the wet climatic belt north of the Central segment is a robust and constant feature of our simulations for the entire studied time period (125-109 Ma). The situation of this belt (ITCZ for Intertropical Convergent Zone) is not disrupted by a rift shoulder of 1000m. Conversely, the presence of a rift shoulder of 3000m plays a major role, the ITCZ becomes discontinuous on the African continent, and a monsoon system occurs on American rift shoulder. On a regional scale, the salinity of the Central segment is controlled by the intensity of runoff. An intense runoff into the Central Segment causes a dilution of seawater, resulting in low salinity. This portion of the South Atlantic is located near of the ITCZ, and is therefore affected by seasonality for both rift shoulders. During the summer in the North hemisphere, the South Atlantic is characterized by a negative precipitation-evaporation (p-e) balance because of the movement of the ITCZ to higher northern latitudes. Conversely during the winter, the South Atlantic is affected by a positive p-e induced by the movement of the ITCZ to lower southern latitudes. The presence of a rift shoulder of 3000m involving a monsoonal system causes a drying of a part of Africa, where the ITCZ is discontinuous. In conclusion, our climatic simulations show that the evaporites of the South Atlantic were not deposited in an arid climate.