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The Hydrocarbon Potential of the Deep Offshore along the Argentine Passive Volcanic Margin – A Basin Modelling Study

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The study area is located offshore Argentina and comprises the outermost shelf, the slope, the rise and even the abyssal plain, and includes the seaward extension of the Colorado Basin. From 1987 to 1999 the Federal Institute for Geosciences and Natural Resources (BGR) measured approximately 20.000 km of multi channel 2-D seismic reflection lines, mostly traversing across the Argentine continental margin. The Colorado Basin and the continent ocean transition zone were additionally covered by BGR refraction seismic profiles (Fig. 1).

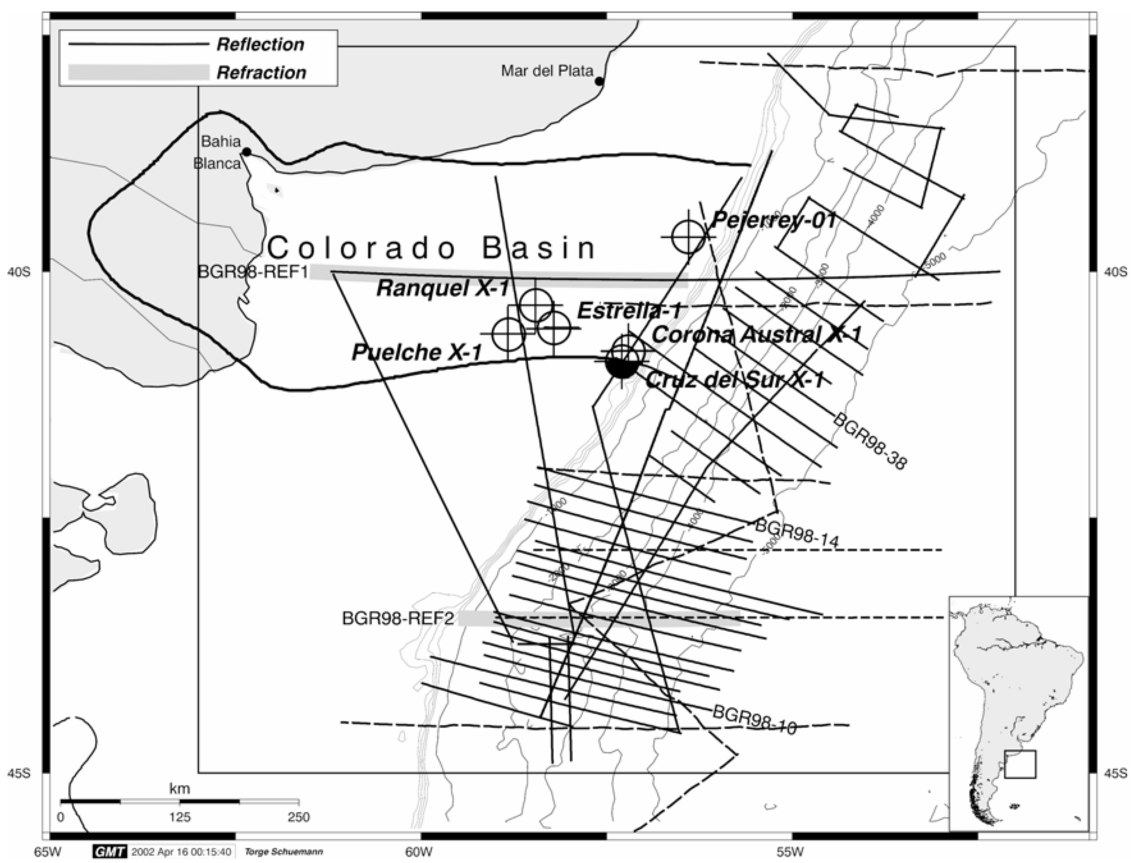

Figure 1: The study area offshore Argentina with multichannel seismic reflection (MSC) and refraction profiles acquired by the BGR. Available well data (provided by YPF/ Repsol) were used to set up 1-D basin models to calibrate palaeo heat flow scenarios, valid for the evolution of the shelf area. Integrated 2-D basin models were calculated along MSC reflection lines BGR98-10, BGR98-14, and BGR98-38.

In the Late Jurassic/Early Cretaceous, continental break-up of Gondwana led to the opening and northward propagating of the South Atlantic (NÜRNBERG & MÜLLER, 1991, LIGHT *et al.*, 1993, DAVISON, 1999). Since 135Ma the Paraná/ Etendeka continental flood basalt provinces and widespread seaward dipping reflector sequences (SDRS) were emplaced (RENNE *et al.*, 1996, STEWARD *et al.*, 1996, GLADCZENKO *et al.*, 1997, HINZ *et al.*, 1999, BAUER *et al.*, 2000), possibly related to elevated asthenospheric temperatures prior to and during rifting (GALLAGHER & HAWKESWORTH, 1992). After break-up thermal subsidence affected predominantly the development of the volcanic continental margins, especially in the elongated zones of the conjugating SDRS. Volcanism during the drift phase, related to the Tristan da Cunha hot spot, caused the Rio Grande/ Walvis Ridge to build up as a submarine barrier, which separated the South Atlantic in a northern and a southern part. North of this barrier non volcanic passive continental margins dominate along the Brazilian and the Angolan coast and thick evaporates were deposited during the mid Cretaceous (DINGLE, 1999, SZATMARI, 2000). South of the Rio Grande/ Walvis Ridge volcanic passive continental margins dominate along the Argentine and the Namibian/ South African coast. Restricted marine conditions during the Barremian and Aptian led to the accumulation of organic rich marine black shales in the Argentine and Cape Basin (BOLLI *et al.*, 1978, NATLAND, 1978, TISSOT *et al.*, 1980, STEIN, 1989).

Based on the BGR seismic data the crustal tectonic structure and the sedimentary evolution of the Argentine passive continental margin were investigated. Along both refraction seismic profiles, oriented perpendicular to the Argentine continental margin, high velocity bodies (v_p=7,0 to 7,5km/s), most probably underplated magma related to the initial process of rifting (GLADCZENKO *et al.*, 1997, BAUER *et al.*, 2000) could be proved. Industry well data from the Argentine continental shelf (Fig. 1) and correlation to seismic stratigraphic interpretation of the conjugated continental margin of Namibia/ South Africa (BROWN *et al.*, 1995) were used to set up a detailed seismic sequence stratigraphic concept for the shelf area and the deep offshore along the Argentine continental margin.

Along strike variations of the depositional regime of the Argentine continental margin locally caused post Cretaceous erosion, as observed SE of the Colorado Basin, while mainly during the Tertiary drift phase a thick sedimentary column was deposited onto the continent ocean transition zone in the southern part of the study area between 43,5°S and 44,5°S, where the total sedimentary thickness reaches more than 6.000m.

Based on the seismic interpretation, integrated 1-D and 2-D basin modelling software, developed at the Institute Français du Pétrole (IFP), was used to model the subsidence of the transition zone in order to establish the tectonic evolution, the sedimentary distribution as well as to give an estimation of compaction and erosion processes. To evaluate the thermal history of the sedimentary pile palaeo heat flow scenarios for the shelf area were calibrated to the available maturity data. Under assumption of an lower plate simple shear margin, according to the rifting model of LISTER *et al.* (1986), these palaeo heat flow scenarios were extrapolated across the shelf edge to the continent-ocean transition zone. Additional heat, derived from magmatic underplating during the initial phase of rifting, was further accounted for, according to the model presented by PEDERSEN (1993).

As a function of the sedimentary cover the zone favourable for the generation of hydrocarbons in the deep domain of the South Atlantic along the Argentine passive volcanic margin is restricted to the southern part of the area under study. With respect to the type of organic matter, these basin models led to estimates of the timing of the maturity of the various source rocks, proposed to occur on the Argentine continental shelf and/ or in the deep offshore of the South Atlantic (TISSOT *et al.*, 1980, STEIN, 1989, FRYKLUND *et al.*, 1996, BUSHNELL *et al.*, 2000). In combination with lithological concepts, derived from seismic facies analysis and available well data, estimates for petroleum systems evolution, migration pathways and possible trap situations can be given.

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