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James Hendry<sup>1</sup>, Deborah Bliefnick<sup>2</sup>, Susan Longacre<sup>3</sup>, Mike Grammer<sup>3</sup>, Antonio Giovannelli<sup>4</sup>, Terry O'Hearn<sup>5</sup>, Mark Votier<sup>6</sup> (1) University of Portsmouth (formerly BG Group, Reading, UK), Portsmouth, United Kingdom (2) Badley-Ashton and Associates (formerly BG Group, Reading, UK), Horncastle, United Kingdom (3) Texaco Upstream Technology, Houston (4) ENI-Agip, San Donato Milanese, Italy (5) Karachaganak Integrated Organisation (KIO), London, United Kingdom (6) Karachaganak Integrated Organisation (KIO), London, England

## **Extensive Dolomitization and Anhydrite Cementation of a Permo-Carboniferous Isolated Carbonate Platform by Large-Scale Seawater Circulation: Karachaganak Field, North Caspian Basin, Kazakhstan**

Poroperm heterogeneity in the giant Karachaganak gas-condensate-oil field is strongly influenced by diagenesis, particularly dolomitization and anhydrite cementation. Understanding the origin and distribution of these processes is fundamental for realistically incorporating their effects into reservoir models.

From early Carboniferous (Viséan) to early Permian (Artinskian) the Karachaganak massif was a large isolated carbonate platform. Dolomite is present throughout, varying considerably in abundance on mm-100m scales. Pervasive dolomitization is most prevalent towards the base and flanks of the Carboniferous and Permian intervals and least abundant centrally beneath the base-Permian and late Artinskian unconformities. Dolomite textures range from mimetic and microcrystalline to coarser fabric-destructive mosaics. Where incomplete, dolomitization affected aragonitic and micritic substrates in preference to calcitic components. The latter were dissolved in completely dolomitised samples. Dolomitization is accompanied by planar to "micro-spheroidal" dolomite cements and by minor to abundant anhydrite cement.

The complex and varied dolomite fabrics are surprisingly conservative in composition. Almost all dolomite is unzoned and uniform in cathodoluminescence, and analysed samples show no statistical difference in isotopic composition between distinct dolomite types. Carboniferous and Permian dolomite  $\delta^{13}\text{C}$ ,  $\delta^{18}\text{O}$  and  $^{87}\text{Sr}/^{86}\text{Sr}$  values are compatible with low-temperature formation (= 408C) from broadly contemporaneous marine fluids. Furthermore,  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $\delta^{34}\text{S}$  analyses of anhydrite samples indicate a comparable marine fluid parentage, based on published secular trends.

We propose that two episodes of platform-scale seawater circulation (mid-late Carboniferous; early-mid Permian) caused the widespread dolomitization and anhydrite cementation. Aragonite-undersaturated seawater was entrained into the platform flanks via geothermal convection and compensatory flow beneath transient meteoric lenses.