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Main diagenetic, porosity and reservoir features of limestone and dolomitic sandbodies from the Middle Jurassic of the Lusitanian Basin, Portugal

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The Middle Jurassic in the Lusitanian Basin (Portugal) corresponds to marine carbonate sucessions, developed on a W/NW dipping ramp. The lower part of the series displays open marine facies, but since the late Bajocian shallow-water deposits are recorded, indicating rapid progradation from E/SE to W/NW. Oolite- and skeletal-dominated sandbodies and other shallow-water facies, namely coral-algal biostromes, lagoonal and peritidal sediments, form several hundred metres thick successions, representing a high-energy ramp system (Azerêdo, 1998). The sandbodies most commonly crop out as thick multistorey units (10 to 15 m up to 50 m, usually 20 to 30 m), with frequent lateral and vertical changes of cross-stratification types and scales and irregular intercalation of other facies types. These sandbodies are chiefly oolitic and bio/intraclastic cross-bedded grainstones and massive to crudely graded, or cross-laminated, oncolitic/bioclastic/lithoclastic rudstones, grainstones and packstones. The cements are dominantly phreatic shallow-marine, composed of non-ferroan, non to weakly luminescent calcite, and later shallow burial to post burial calcite or dolomite/dedolomite, usually defining this “stratigraphic” pattern: earliest circumgranular, most frequently isopachous, fibrous or bladed calcite; one or more generations of equant or drusy spar, locally showing compromise boundaries; late, poikilotopic or syntaxial calcite may also be present. Exceptions to this general pattern exist, in particular the lack of the early circumgranular cement, favouring the development of compactional features.

Most sandbody facies exhibit low to very low actual estimated porosities (clearly <5%), because the secondary porosity created by multi-phase leaching or dolomitisation (biomouldic, oomouldic, intragranular/intracrystalline and vuggy porosity) and, less frequently, by fracturing and pressure dissolution (micro/mesoscale fractures, stylolites or farctures locally enlarged by dissolution, intercrystalline porosity) was, in most cases, almost contemporaneously or shortly after occluded; besides, observed connectivity only locally is fair or good. The overall reservoir rock potential of this sandbody facies is low.

However, a distinct situation is recognised at a particular interval (10’s metres thick) of the regional succession, that corresponds to dolostones and dolomitic limestones with fair to high (from 6-7% to >20%) porosities (including microporosity). Though completely crystalline mosaics without signs of the original precursor occur, commonly these dolomitic rocks display crystalline textures with relics or ghosts of original grain-supported textures (grainstones/packstones), or floating-rhomb fabrics in peloidal-oncoidal wackestone/packstones or oobioclastic grainstones; former early phreatic fibrous circumgranular and/or vadose cements may be locally seen. Pore types are mainly interparticle/intercrystalline pores, oomoulds and vugs (from small vuggy to cavernous porosity) and the observed connectivity is variable. Dolomicrites also exist, but these are in peritidal deposits and may occur at several intervals of the succession. Later dolomites related to local or regional faulting systems are present also, usually exhibiting distinct petrographic and/or macroscopic characteristics, namely clear association with fractures and dissolution fabrics, secondary void-filling dolomite or multi-generation rhombs. The reservoir rock potential of the dolomitic sandbody-facies ranges from low to high. Further studies may allow better constraining the distribution and controls on this heterogeneous reservoir quality.

Azerêdo, A. C. (1998) - Geometry and facies dynamics of Middle Jurassic carbonate ramp sandbodies, west-central Portugal. In: Carbonate Ramps (Eds V. P. Wright and T. Burchette), Geol. Soc. London Spec. Publ., 149, 281-314.