From numerical geology to structural diagenesis – a way to understand Naturally Fractured Carbonate Reservoirs : a tribute to Juliette Lamarche

Philippe Léonide*[1], Franck Gisquet , Cédric Guyonnet-Benaize , Arthur Lavenu , Irène Aubert , Pierre-Olivier Bruna , Paul Namongo-Soro , Pascal Richard , Sophie Viseur[2], Lionel Marié[3], Jean Borgomano[2], and Olivier Bellier[4,5]

[1]Centre européen de recherche et d'enseignement de géosciences de l'environnement (CEREGE) – Aix Marseille Université, INSU, Institut de recherche pour le développement [IRD], CNRS : UMR7330 – Europôle Méditerranéen de l'Arbois - Avenue Louis Philibert - BP 80 - 13545 Aix-en-Provence cedex 4, France

[2]Centre européen de recherche et d'enseignement des géosciences de l'environnement – Institut de Recherche pour le Développement, Aix Marseille Université, Collège de France, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement, Institut de Recherche pour le Développement : UMR$_D$161, $AixMarseilleUniversité : UM34, CollègedeFrance :$ $UMR7330, CentreNationaldelaRechercheScientifique :$ $UMR7330, InstitutNationaldeRecherchepourl'Agriculture, l'Alimentationetl'Environnement :$ $UMR1410 - -France$

[3]Centre européen de recherche et d'enseignement de géosciences de l'environnement (CEREGE) – Aix Marseille Université, CNRS : UMR7330 – 3, place Victor Hugo Case 67 13331 Marseille Cedex 03, France

[4]Centre européen de recherche et d'enseignement des géosciences de l'environnement – Institut de Recherche pour le Développement, Aix Marseille Université, Collège de France, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement, Institut de Recherche pour le Développement : UMR$_D$161, $AixMarseilleUniversité : UM34, CollègedeFrance :$ $UMR7330, CentreNationaldelaRechercheScientifique :$ $UMR7330, InstitutNationaldeRecherchepourl'Agriculture, l'Alimentationetl'Environnement :$ $UMR1410 - -France$

[5]Ecosystèmes continentaux et risques environnementaux – Aix Marseille Université, Centre National de la Recherche Scientifique – France

Résumé

In this presentation, we examine almost two decades of research by Juliette Lamarche on fractured carbonate reservoir analogs and 3D structural basin modeling.
A key innovation in Lamarche's work lies in the integration of detailed outcrop-based structural analyses with advanced 3D modeling techniques. This approach enables the consolidation of multi-scale structural datasets into coherent, geologically consistent 3D models, thereby providing robust numerical constraints on tectonic and stratigraphic interpretations.

*Intervenant

Her methodological framework encompasses structural data acquisition and analysis in outcrops, geological mapping, construction of balanced cross-sections to reconstruct geometries and kinematics in regional domains/sedimentary basins, paleostress reconstructions, and the integration of diagenetic, structural, and U-Pb geochronological data.

Juliette Lamarche has employed 3D structural modeling based on surface (field and Lidar) and subsurface (seismic and borehole) data. More recently, her work has extended to the use of fractured reservoir modeling tools such as PRFrac, along with the implementation of these models within immersive virtual reality environments, such as VirtuaField.

This tribute, primarily drawing upon the works of Gisquet et al. (2008), Guyonnet Benaize et al. (2010), Lavenu et al. (2013), Bruna et al. (2015) and Aubert et al. (2023), highlights several key contributions:

1) Methodological advances: integration of discrete structural measurements from outcrops into unified, multi-scale 3D models aiming at better understanding subsurface heterogeneities to sustainably exploit naturally fractured reservoirs and reduce associated industrial risks (Gisquet et al., 2008; Bruna et al., 2015);

2) Regional geodynamic findings: Contributions to the understanding of Mesozoic geodynamics in Provence, particularly regarding the Durancian extensional phase and subsequent Pyrenean-Provençal compressive events (Guyonnet Benaize et al. , 2010) ;

3) Tectono-diagenetic interactions: Demonstration of the tight coupling between brittle deformation and diagenetic processes in naturally fractured carbonate systems (Lavenu et al., 2013).
4) Diagenetic evolution of faults: Development of an integrative methodology to characterize the polyphase diagenetic history of normal faults, enabling the discrimination of fluid flow-related diagenetic stages associated with successive faulting and reactivation events (Aubert et al., 2023).