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3D Geologic Modeling. The example of the Farim-Saliquinhé Phosphates Mineralization.

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The construction of three-dimensional geologic models representing both the structure and properties inherent to each geological unit is nowadays possible due to the computational development of the last decades. The 3D Geologic Modeling (3DGM) is very efficient for storage, display and transfer of geoscience information, and is a key tool in the oil industry in particular for the reservoir characterization and modeling; its use in other geosciences areas has been growing in recent years but is still scarce.
In the present work we show a 3D geologic model of the phosphates mineralization of Farim-Saliquinhé (Guinea-Bissau) as a first example of the work being developed in the research center CICEGe (FCT-UNL) by its novel research group on 3DGM, and to demonstrate the usefulness of this kind of geologic models, built with appropriate software, in order to better represent, study, characterize and visualize a geologic case study.
The phosphates mineralization of Farim-Saliquinhé (Guinea-Bissau) is a sedimentary deposit located near Saliquinhé, Farim and the Rio Cachéu. The deposit is composed by two members: 1) FPB, an early Middle to Upper Lutetian calcareous-phosphate member; 2) FPA, an upper member of descarbonatized phosphate. Micritic limestones are underlying the mineralized layers, while dolomitic limestones, the FPO phosphate interval, and a younger sandy clayey cover are overlying the phosphatic members (BRGM, 1983; Prian et al., 1987).
This work is based on geologic and geochemical data from 69 vertical boreholes carried out by BRGM in the 80s (completed with topographic data). This survey covered an area of about 10x5 km and was aimed to determine the geometry and the reserves of the FPA and FPB phosphate mineralization. The 3D geologic model was developed in gOcad software, which uses a distinctive interpolation method to build the geometry of objects, the DSI - discrete smooth interpolation.
The 3D geologic model was built on the BRGM's study area (Prian et al., 1987) in order to enable comparison of results. We have constructed a surface that models the terrain topography, and surfaces representing the geologic contacts between 1) the overlying cover and the FPA member; 2) the FPA and FPB members and 3) the FPB (or FPA, when FPB is absent) and the underlying micritic limestones.
Based on the constructed surfaces, a three-dimensional mesh was build. Since the modeled contacts are considered erosive, we decided to make the 3D mesh parallel to the wall and truncated by the top of each of the modeled members. The resulting mesh (grid) has 140x149x108 cells, sizing 50m x 50m x 0.20m, along the axes X, Y, Z respectively, covering the volume of the mineralized FPA and FPB layers.
An estimate of the P2O5, Al2O3, CaO, CO2, F, Fe2O3, MgO and SiO2 contents for each cell of the 3D mesh was attempted following the geochemical information available from the boreholes. We present the results for P2O5 and CaO. We also show some results computed from the 3D model, such as FPA and FPB thickness and volume. Results obtained with and from the 3D model are compared with those from the BRGM (BRGM, 1983; Prian et al., 1987).

References

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