• increase the awareness of both the scientists and the public on the importance of ethical aspects in Earth and Environmental sciences;
• establish a shared ethical reference framework, to be adopted by RIs governing bodies;
• increase the awareness of RIs management and operational levels and of the individual involved scientists on their social role in conducting research activities and research work environment;
• assess the ethical and social aspects related to the results achieved and deliverables released within the project.

As one element of this work we created a questionnaire to investigate how each RI participating in ENVRI Plus faces ethical issues in relation to its activities, and so to understand the level of perception that researchers and technicians involved in the project have on the ethical implications of their scientific activities.

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# U-Pb geochronology of the El Jadida rhyolite and relation to possible Lower Cambrian recycling (Coastal block, Moroccan Meseta)

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The El Jadida (Mazagan) dome, whose existence was reported as early as 1934 by Yovanovitch and Freys, constitutes one of the first outcrops of the Moroccan Meseta where the Precambrian (PIII?)-Paleozoic (Lower Cambrian?) boundary was established (Gigout, 1951; Cornée et *al*., 1984). Since then, it is listed as one of the few locations where the basement of the Moroccan Variscan belt can be observed (Hoepffner et *al*.. 2005; Michard et *al*., 2010).Despite, the absence of geochronological and biostratigraphic precise data to constrain the time interval recorded here, there are stratigraphic similarities that allow a correlation with the Ediacaran-Cambrian geological record of Anti-Atlas belt (Cornée et *al*., 1984). In this study, we developed a petrographic, geochemical and U-Pb geochronological study using zircon extracted from: (*i*) the El Jadida rhyolite with the aim of characterizing the magma source and estimate the age of crystallization; (*ii*) a microbreccia sampled at the base of the El Jadida Dolomitic Formation for determining provenance.

The El Jadida rhyolite consists exclusively of rhyolites, rhyolitic ignimbrites with flame structures and tuff-breccia with xenoliths of rhyolite, granite and foliated metapelites (evidence of Precambrian deformation). Two main textural varieties were recognized: i) porphyritic with quartz and feldspar phenocrysts enclosed by a fine grained matrix and ii) vitroclastic porphyritic with quartz and feldspar phenocrysts surrounded by glass shards underlining the fluidity of the volcanic rock. Geochemically, the El Jadida rhyolites have high-K calc-alkaline signature with Nd negative anomaly and chondrite normalized trace-element patterns similar to those of the upper continental crust (UCC), suggesting crustal contamination (El Houicha et *al*., in press). In the Nb vs Y and Rb vs (Y+Nb) tectonic discrimination diagrams (Pearce et *al*., 1984), El Jadida rhyolites fall within the limits of the volcanic arc+syn-collisional granites and within plategranites fields. The oldest zircon grains are Paleoproterozoic (2.1 Ga) and Ediacaran (ca. 625, 624 and 615 Ma) xenocrysts. The remaining analyses, with ages ranging from ca. 597 to 570 Ma, give a weighted mean of 584.2 ± 4.8 Ma (Ediacaran), considered the best estimate of the age of crystallization of the El Jadida rhyolite (El Houicha et *al*., in press). This age is slightly older than ca. 581-578 Ma (El Haibi et *al*., 2017) and younger than ca. 597.6± 4.6 Ma (Youbi et *al*., 2017) recently obtained for the El Jadida rhyolite and fall in the age range of ca. 615-579 Ma achieved for the high-K calc-alkaline granitic rocks with chemical features indicating a syn-subduction/collisional setting of the Anti-Atlas belt (*i.e*. the Assarag suite and correlatives; Thomas et *al*., 2004). It also coincides with the magmatic activity (Cadomian magmatic arc) that lasted from ca. 590 to 550 Ma, during the Ediacaran sedimentation in Iberia (Pereira, 2014 and references therein).

The Neoproterozoic basement represented by the El Jadida rhyolite is unconformably overlain by siliciclastic and carbonate rocks of probable Lower Cambrian age (El Jadida Dolomitic Formation; Gigout, 1951; Cornée et *al*., 1984; El Houicha et *al*., 2002). A layer of microbreccia interbedded with beds of dolostone and arkosic sandstone from El Jadida Dolomitic Formation was studied from the petrographic point of view and detrital zircon-age spectra for determining provenance. Microbreccia includes many angular and subangular fragments of rhyolite and andesite. Detrital zircons grains are euhedral and prismatic, with well-preserved bi-pyramidal terminations, angular and subangular indicating rapid deposition with little transport. Detrital zircon-age spectra show a main age peak at ca. 583-582 Ma suggesting direct recycling of El Jadida rhyolite as an important original primary source (El Houicha et *al*., in press). The youngest detrital zircon grain indicates aprobable maximum depositional age of ca. 539 Ma (Lower Cambrian). The age interval between ca. 584 Ma magmatism (El Jadida rhyolite) and the maximum depositional age of ca. 539 Ma obtained for the El Jadida Dolomitic Formation allows for the estimation of a minimum stratigraphic gap of more than 45 million years (Lower Cambrian unconformity).

The end of Ediacaran arc magmatism and the denudation of the Neoproterozoic basement and deposition of Lower Cambrian siliciclastic and carbonate formations mark the switch from an active to a passive continental margin setting. Stress regime inversion in the continental crust from compression to crustal extension probably caused the development of basins controlled by the formation of graben-horst systems (Bernardin et *al*., 1988; Piqué, 2003). The uplift of tilted-blocks separated by graben-horst-bounding faults was possibly responsible for the erosion of the Neoproterozoic crystalline basement exposed in escarpments and rift shoulders, in a paleolocation close to the West African Craton.

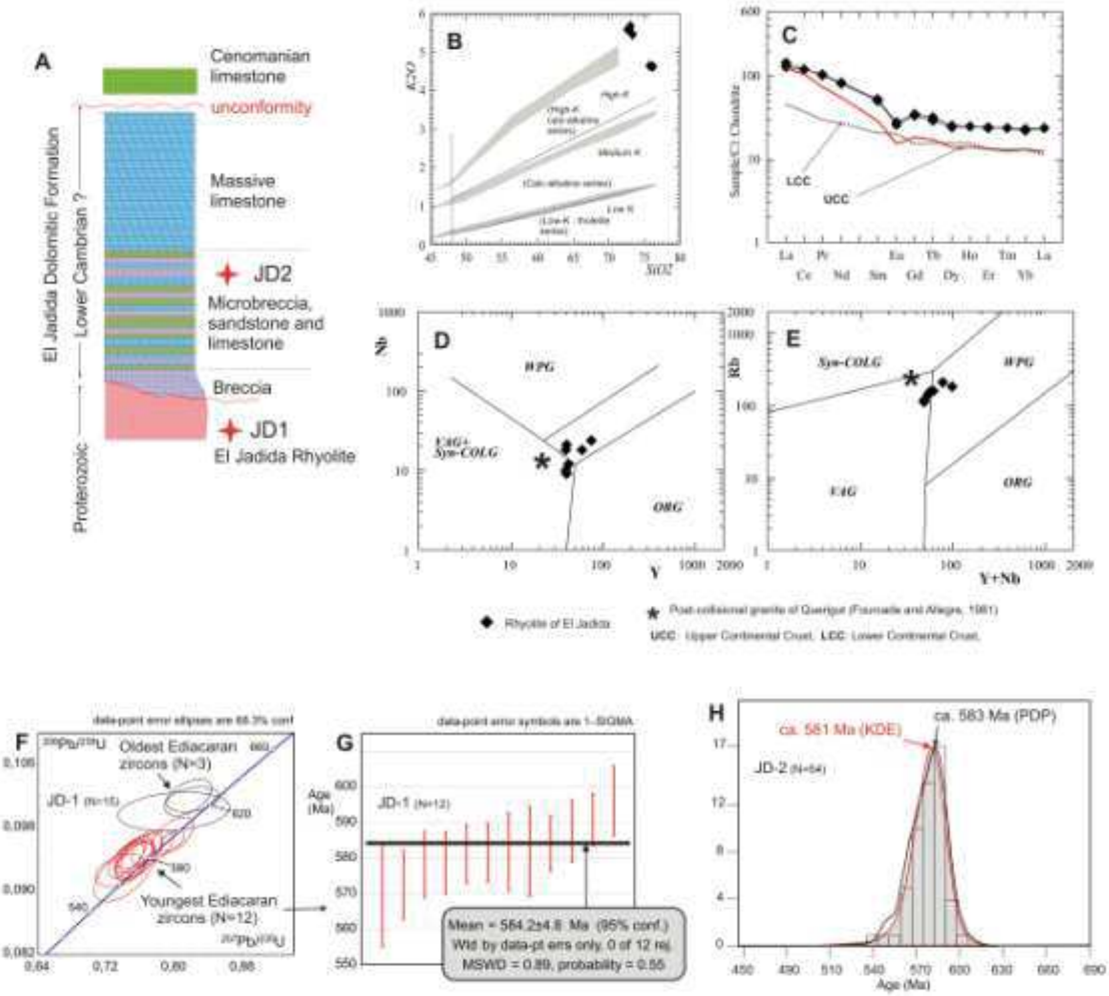


Figure 1 (a) Simplified lithostratigraphy showing the post- Cadomian/Pan-African unconformity (adapted from Cornée et al., 1984);(b) Geochemical plots of El Jadida rhyolite in the $K_2O$ vs $SiO_2$ diagram showing the subdivision of subalkalic fields. Broken lines with nomenclature in italics are from Le Maitre et al. (1989) and the shaded bands are from Peccerillo and Taylor (1976) and Rickwood (1989); (c) Chondrite normalized REE of the El Jadida rhyolite. Normalization values are from Sun and McDounough (1989). UCC- upper continental crust; LCC- lower continental crust; (d) and (e) Plots of the El Jadida rhyolite in the discriminant diagrams of Pearce et al. (1984). Asterisk represents the Quérigut post-collisional granite of (in Fourcade and Allègre, 1981); VAG- volcanic arc granite; ORG- oceanic ridge granite; WPG- within plate granite; Syn-COLG- syn-collisional granite.U-Pb data: f) concordia diagram and (g) weighted mean for zircon from sample JD1 (El Jadida rhyolite); (h) Wetherill concordia plot for the microbreccia sampled in the El Jadida Dome (El Jadida Dolomitic Formation; sample JD2) (Adapted from El Houicha et al., in press).

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## Reservoir characterization and geological modeling of pindori oil field, Kohat-Potwar plateau, Pakistan

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Kohat-Potwar Plateau is one of the most hydrocarbon productive basins of Pakistan. The oldest discovery of the country was made in this basin. Since several producing fields are depleting because of long production history there is challenging need of reservoir characterization and modeling for optimum recovery from these fields. Pindori oil field is one of them. It is producing oil from the fractured carbonates of Paleocene and Eocene. So far it has produced ~22 MMbbl of equivalent oil. Predicting the reservoir behavior for its future development and performance is key to optimum hydrocarbon exploitation. The extent of oil/gas recovery from a mature field has become important to determine the expense of exploitation especially in case of low oil prices. Set of equations and assumptions are required to build a model that describes the active processes of the reservoir. Many reservoir prediction models are based upon factual deceptions and results in poor description of the reservoir behavior and consequently a low oil recovery. Static models of Pindori have been constructed successfully, and these models appear adequate to represent the production performance of the field and of the key producing wells. However, the production performance can be reproduced with a STOIIP ranging from approx. 50 – 110 MMstb. Key uncertainties are the storage capacities of the connected fracture network and the effective in-situ rock compressibility. Although available data quality and quantity significantly affects the results of a reservoir prediction model but the incorrect and unaccounted or biased assumptions proved to be the main cause of poor reservoir model. In this study a reservoir modeling for fractured carbonates has been carried out based upon available geological, geophysical and engineering data. Standard procedures are established to determine the lithology, porosity and permeability of the field. Fractures are characterized and heterogeneous nature of fracture network is established to indicate the storage and flow capacity of the field. On the basis of geological and geophysical data facies and reservoir petrophysical property maps were generated. Fracture density increases updip into the crestal area of the structure. Single oil water contact (OWC) could not be established for the Pindori oil field which may points towards the compartmentalized nature of the structure. The data suggests that fracture density increases updip into the crestal area of the structure. The data also suggests that fractures steepen updip and mainly dip to the north, whilst in the downdip flank areas of the structure fracture dips are less steep and dip mainly to the south. However, given the differing vintages