



**L'importance de la présence de dykes et filons de quartz
fracturés pour la recherche d'eau dans les roches
métamorphiques argileuses**

**The importance of the presence of fractured quartz dykes and
veins in groundwater prospecting in metamorphic clayish rocks**

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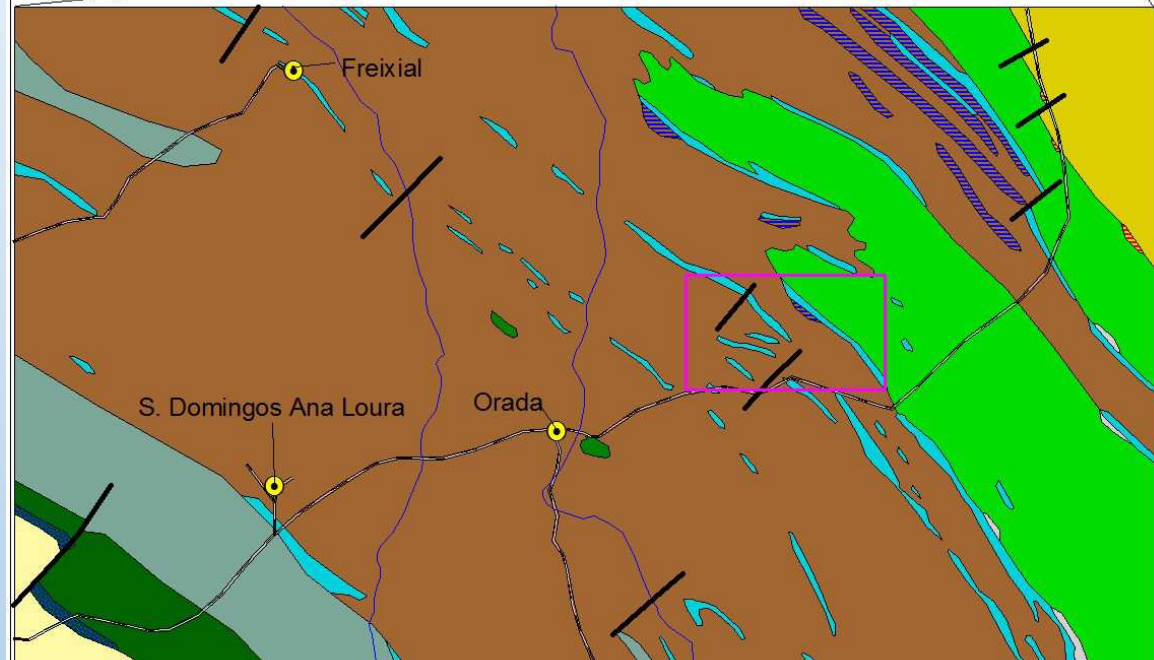
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LEGEND

Estremoz-Capelins Region

- Silurian-Devonian - Schists Raiados Formation: Quartzites
- Silurian-Devonian - Schists Raiados Formation
- Silurian - Schists with Nodules Formation
- Ordovician - Colorada Formation
- Lower Ordovician - Barrancos Formation
- Medium-Upper Cambrian - Quartzite level with Fe and Mn
- Medium-Upper Cambrian - Fatuquedo Formation

Estremoz-Ferrarias Anticline

- Cambrian - Vulcano-Sedimentar Complex of Estremoz - Acid Rocks
- Lower Cambrian - Dolomitic Formation
- Lower Cambrian - Vulcanoclastic Member
- Upper Precambrian - Mares Formation

- Local Study area
- Faults
- Rivers
- Villages
- Roads

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GEOLOGY AND HYDROGEOLOGY

- The region has a temperate climate, moderately rainy with multi-year droughts. The average annual rainfall is 637 mm/year and the annual average temperature is 16.2 °C.
- From the hydrogeological point of view, this region is integrated in a hard rock media context, which means generally very **low permeabilities and transmissivities and low yields**.
- But there are always **references to exceptional yields in specific geologic/tectonic environments**.
- In the study area, the main rocks are metamorphic, namely **schists**, with some thin layers of **lydites and quartzites**, sometimes associated **with the presence of quartz fractured dykes and/or veins**.
- The region is part of the Low Productivity Aquifers of South Portugal, where the average productivity is normally around 1 L/s. The schists are very clayish and are characterized by a low density of fractures.
- The most common water points are old large dug wells, able to support the livestock water demand. Drilled wells are normally used for water supply to houses in the proprieties and for cattle, rather than for extensive agriculture.



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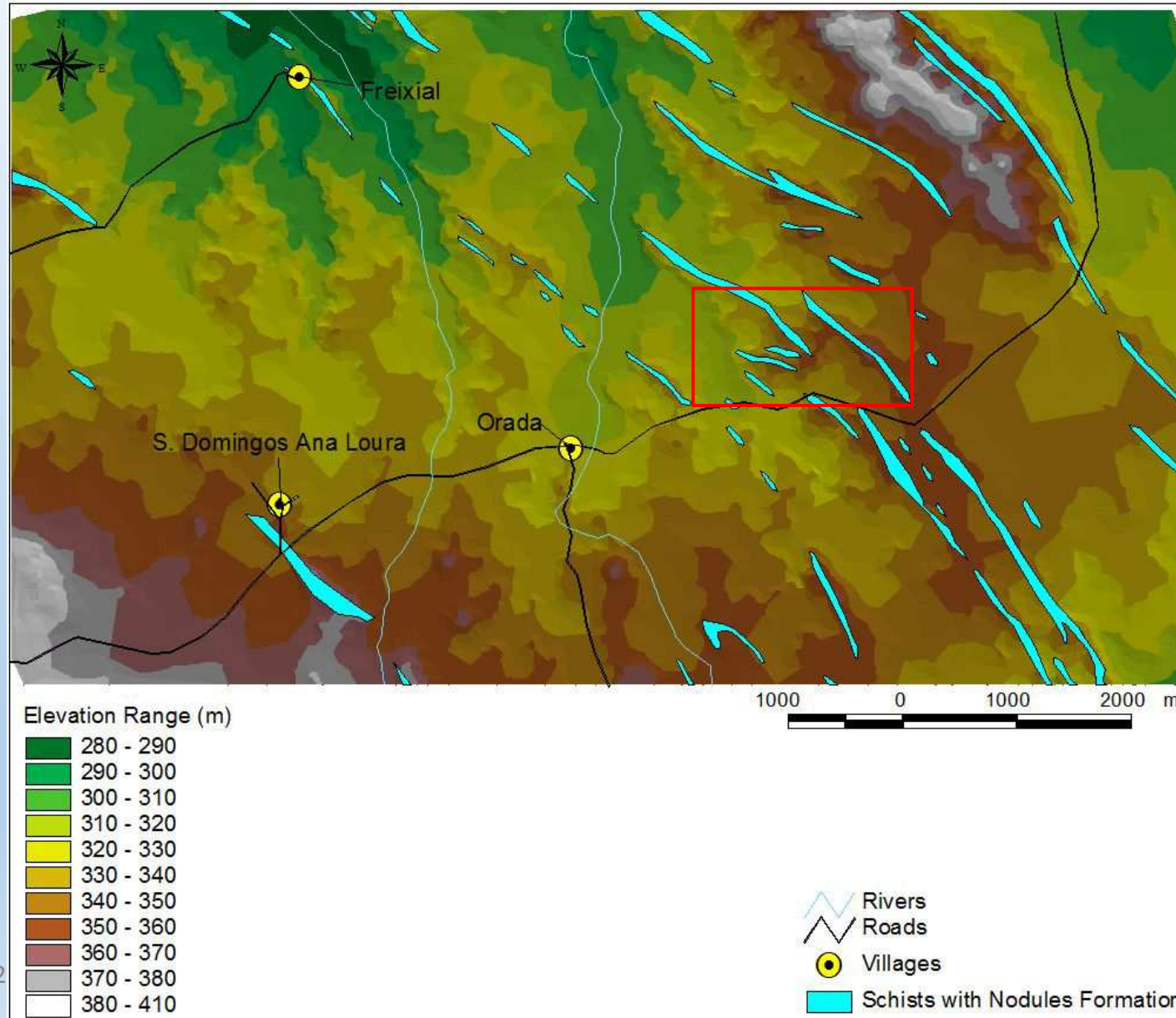


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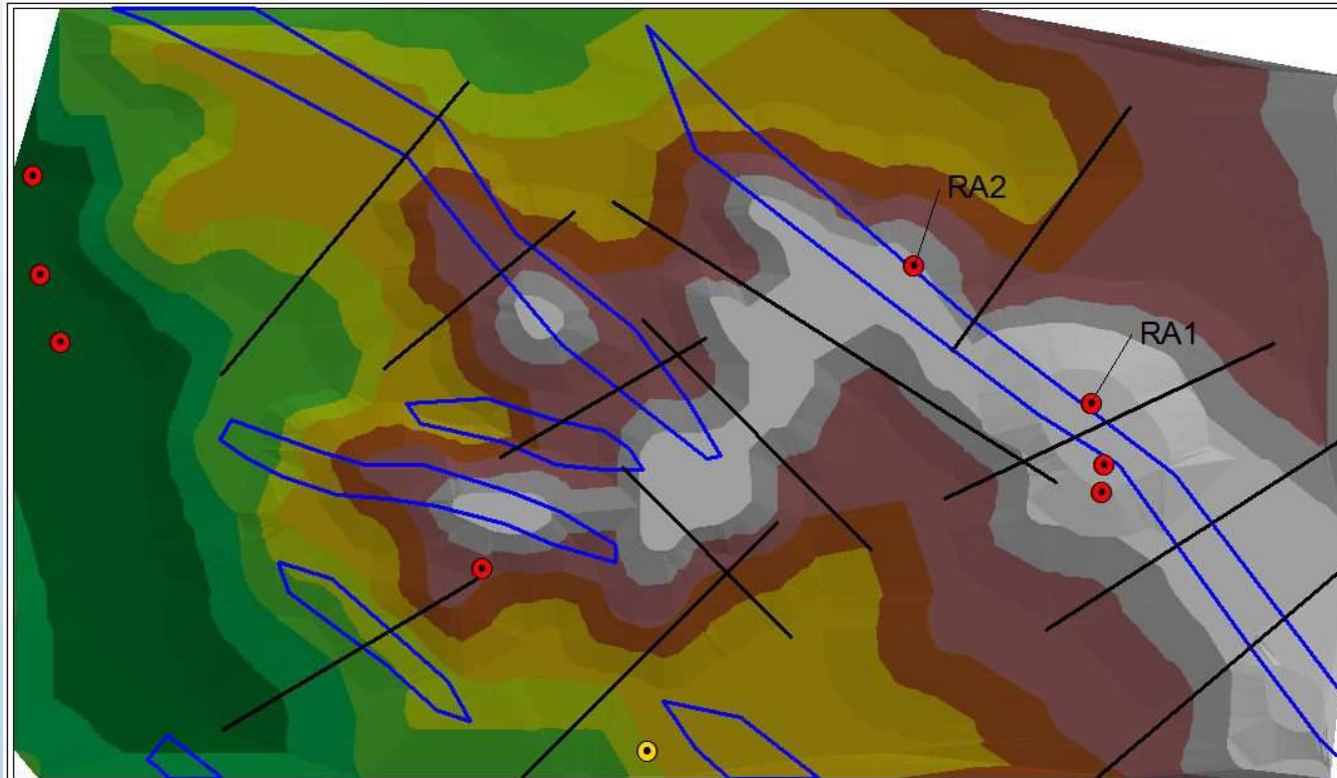


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LEGEND
Elevation Range (m)

White	350 - 360
Light Gray	345 - 350
Dark Gray	340 - 345
Brown	335 - 340
Yellow-Green	330 - 335
Yellow	325 - 330
Light Green	320 - 325
Green	315 - 320
Dark Green	310 - 315

-  Faults
-  Drilled well
-  Dug well
-  Schists with Nodules Formation



GEOLOGY AND HYDROGEOLOGY

- In 2013, after a geological approach and field work, a well (RA1) was performed in a thin outcrop of the Schists with Nodules Formation.
- The yield of this well was **19 L/s** measured with compressed air in the end of drilling, and the litologies crossed were black schists and lydites, where black cherts dominate.
- In the study area this kind of rocks are related to the occurrence of long white quartz dykes, highly fractured and limonitized.
- The shape of the relief is also intimately associated to black schists and lydites with quartz occurrence. Hills are aligned with the Schists with Nodules Formation with quartz fractured veins and dykes.

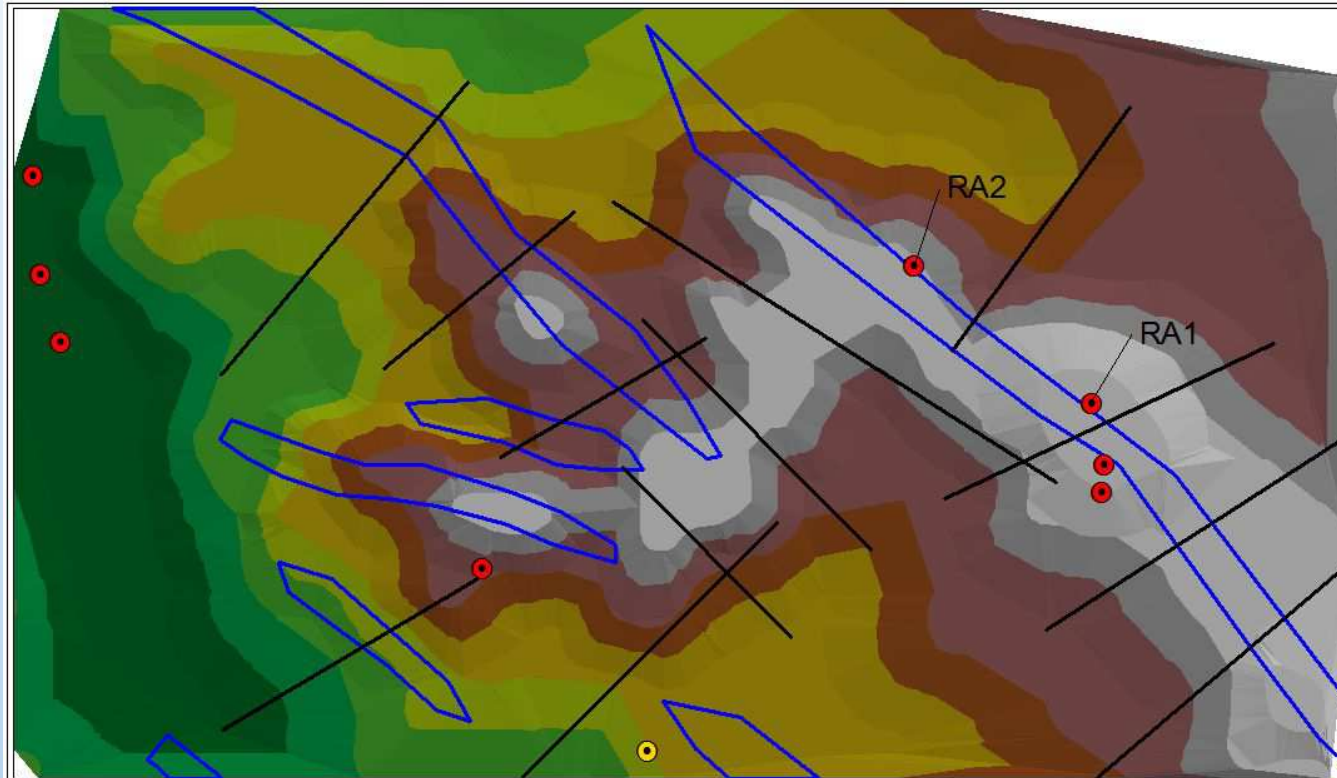


GEOLOGY AND HYDROGEOLOGY

- The well RA1 was drilled in the top of one of the highest hill, in the NE flank of Schists with Nodules Formation layer. In the field, an occurrence of a metric quartz dyke is visible, and several lydite and quartz evidences are also detected in the soil.
- The borehole is 148 m deep. It crossed also psammites and graphitic schists.
- At the deep of 90 m, a 12 m quartz dyke with productivity of 2 L/s was crossed.
- Between 100 and 108 m and between 120 and 147 m deep, lydites and heavy fractured and limonitized quartz mixed with lydites and greywackes were also crossed.
- At this stage the groundwater yield reached 19 L/s, using the compressed air in the end of drilling.
- A 24 h aquifer test was performed with a submersible pump, using a 12 L/s pumping flow.
- The static level was 49.54 m and the dynamic level was 51.07 m (specific capacity of 680 m²/day).



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- Faults
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GEOLOGY AND HYDROGEOLOGY

- Meanwhile, between 2013 and 2015 many neighbours around this Orada Vineyard propriety did several wells inside the Schists Raiados Formation. The results were not positive and the productivity varied between 0 and 1.5 L/s.
- In the beginning of 2015 another well (RA2) was drilled in the same Schists with Nodules Formation alignment. This new well has 151 m deep, and is located more than 330 m NW of RA1.
- The rocks crossed were psamites and graphitic schists, and, at 60 m deep, a 9 m quartz dyke was cut, producing 2 L/s. Between 86 m and 98 m, 113 and 128 m, and 133 and 137 m deep, a highly fractured lydite, with white limonitized quartz was crossed. In a total of four productive levels, yield reached 28 L/s using compressed air.
- There isn't any hydraulic contact between RA1 and RA2
- Static level was 50.4 m and dynamic level 55.3 m (completely stabilized after 8 h of pumping), which reach a specific capacity of 264 m²/day.
- The difference between the 28 L/s measured by compressed air and the 15 L/s obtained in the aquifer test was due to the reduced diameter of casing (200 mm) and to the water pump available to do the job.



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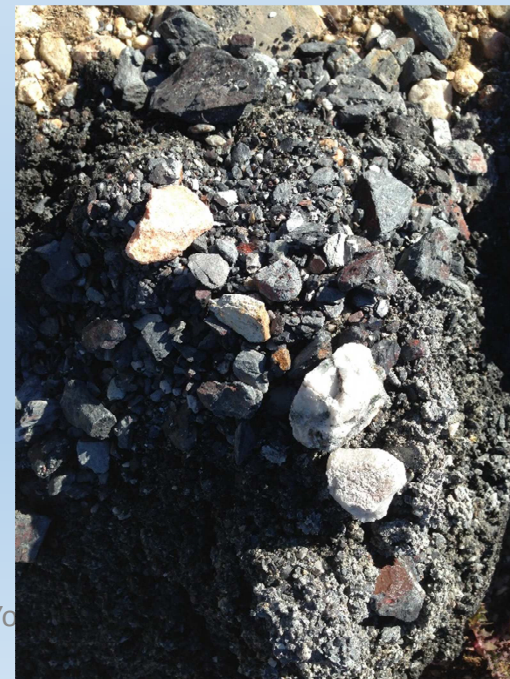
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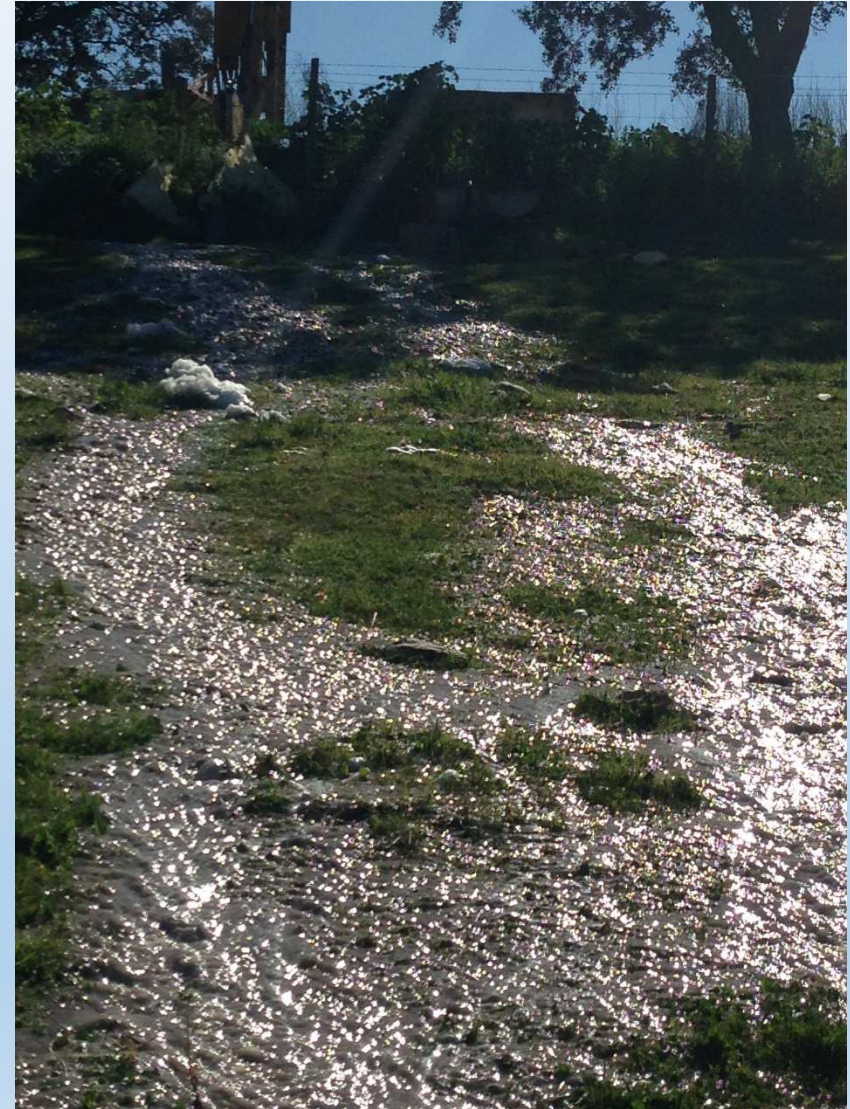
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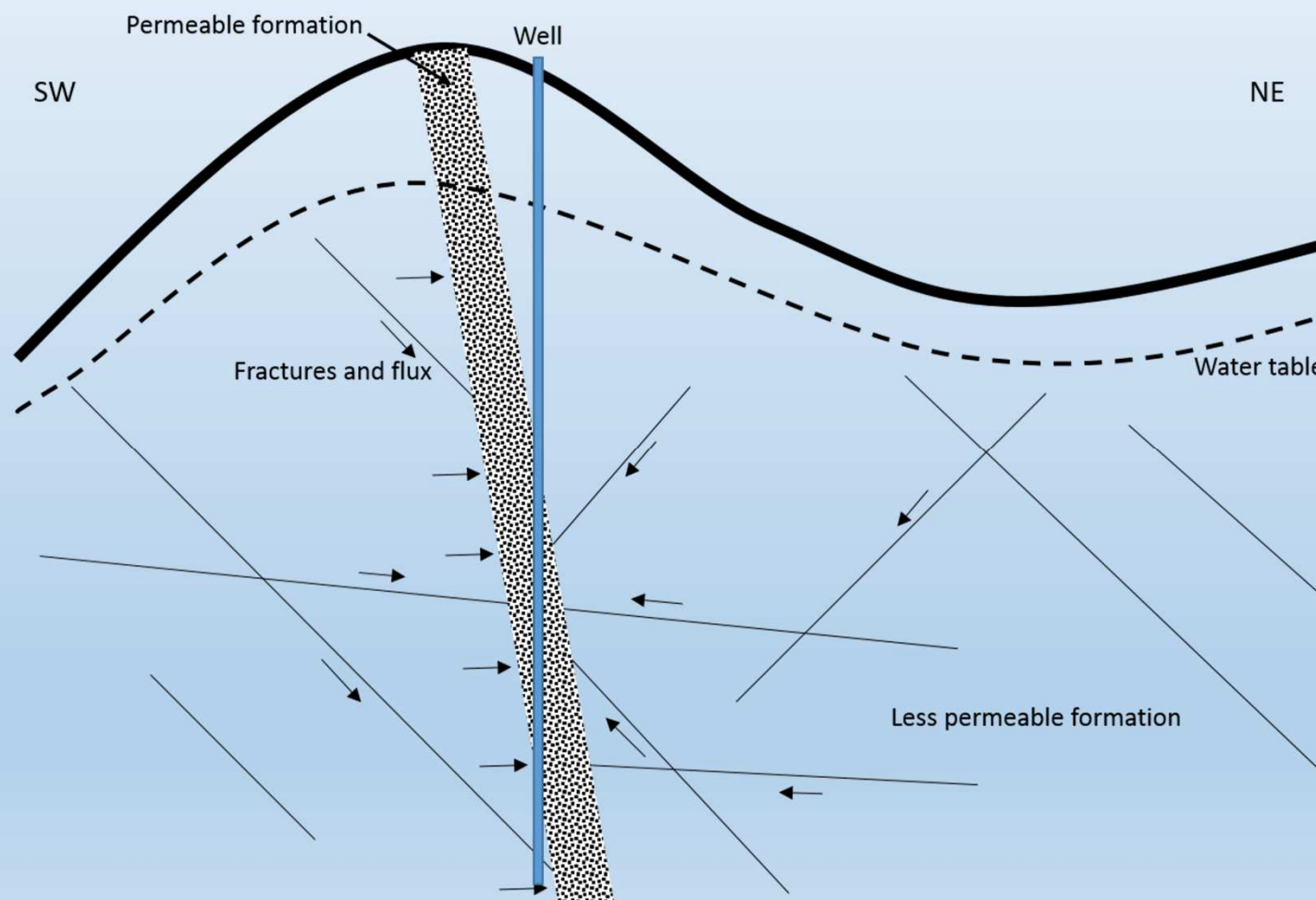
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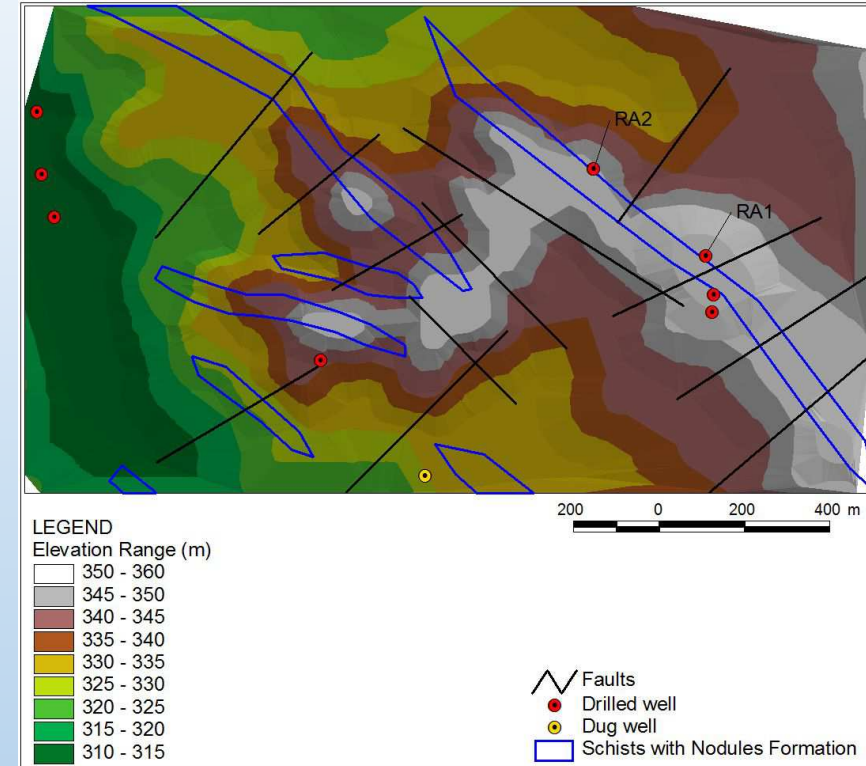
CONCEPTUAL MODEL





FINAL REMARKS

- The result was two wells with yields of 19 and 28 l/s (using compressed air) and, after well tests performed with submersible pumps during 24 h, with recommend yields of 12 and 15 L/s, respectively. The specific yield for each one was respectively 680 and 264 m²/day.
- There are more occurrences like this in South Portugal, some reported others not yet reported, in other geologic unities. In a few weeks another situation like this one will be tested.
- The conceptual model accepts that the lydites and quartz dykes will behave like conduits draining the water from neighbouring formations.
- Once this wells are recent, there is not yet the perception for how long time these structures can be reliable before any drawdown on the water levels and in productivity can be noticed.





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