

DEEP EXPLORATORY DRILLING FOR WAJID SANDSTONE RESERVOIRS

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INTRODUCTION

The Wajid Sandstone forms a principal reservoir in the Southwestern of the Arabian Peninsula. The aquifer system is a succession of Paleozoic siliciclastic deposits. During 2007-2009 extensive exploratory drilling campaign conducted by Abu Degen Company for Drilling Wells (as contractor for GIZ/DCo) within the frame of the Wajid Water Resources Studies (Ministry of Water and Electricity-GIZ/DCo : Consultant)

Within this work, (24) drilling sites with total depth of 13.40 km were drilled. The work included detailed borehole geophysical logging and geohydraulic testing. In addition, (20) existing wells were geophysically logged with detailed camera inspection.

The drilling exploratory campaign has shown that in the subsurface, the Wajid Sandstone succession represents two individual fractured bedrock aquifers separated by an aquitard. The lower aquifer is represented by the Dibsiyah Formation and the lower Sanamah Formation. The lower aquifer system (the lower sandstone sequence) is totally separated from the upper aquifer system by the shales and siltstones of Qalibah Formation. The upper aquifer system comprises the Khusayyan Formation and the Juwail Formation. (Fig. 1)

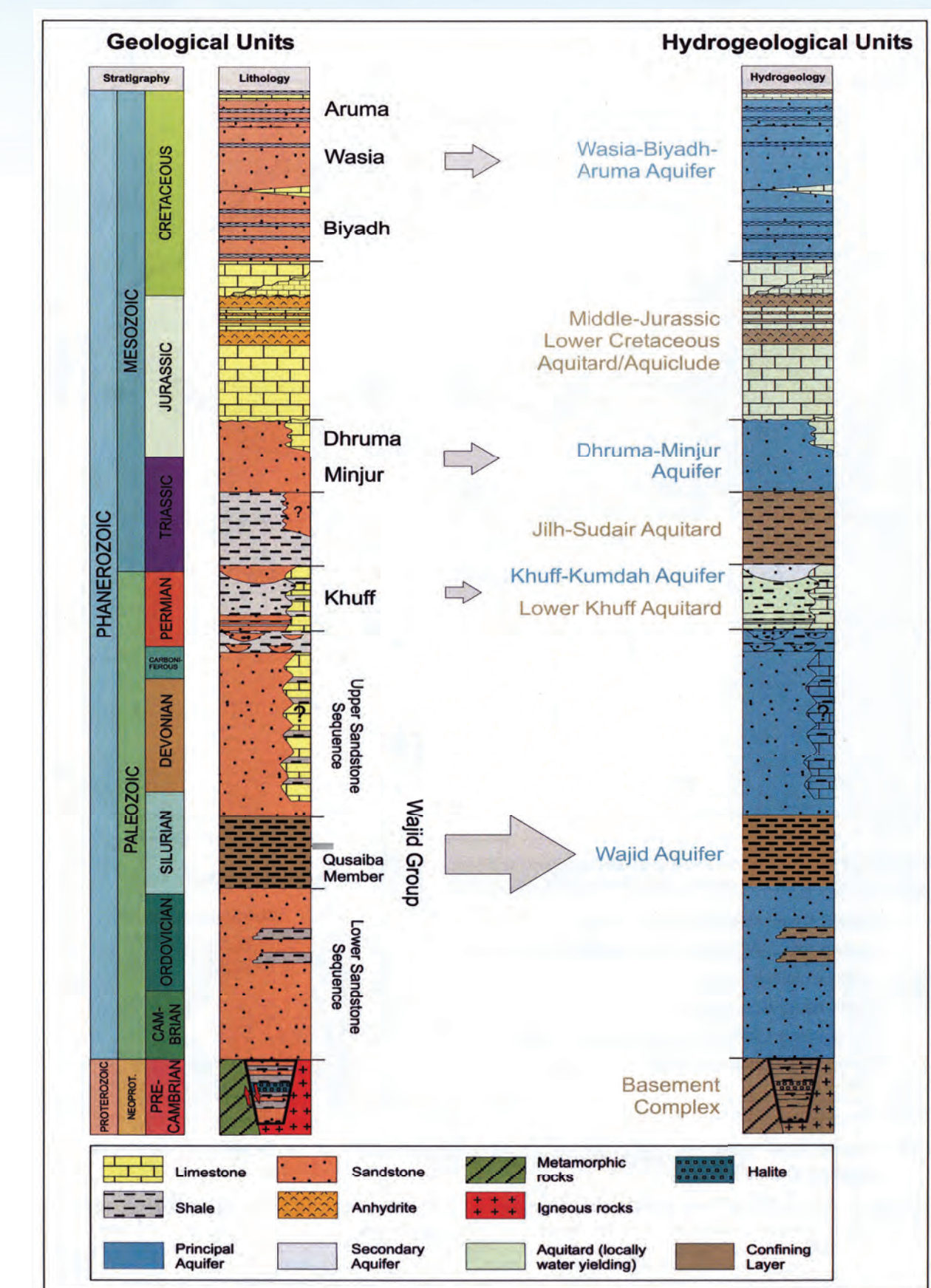
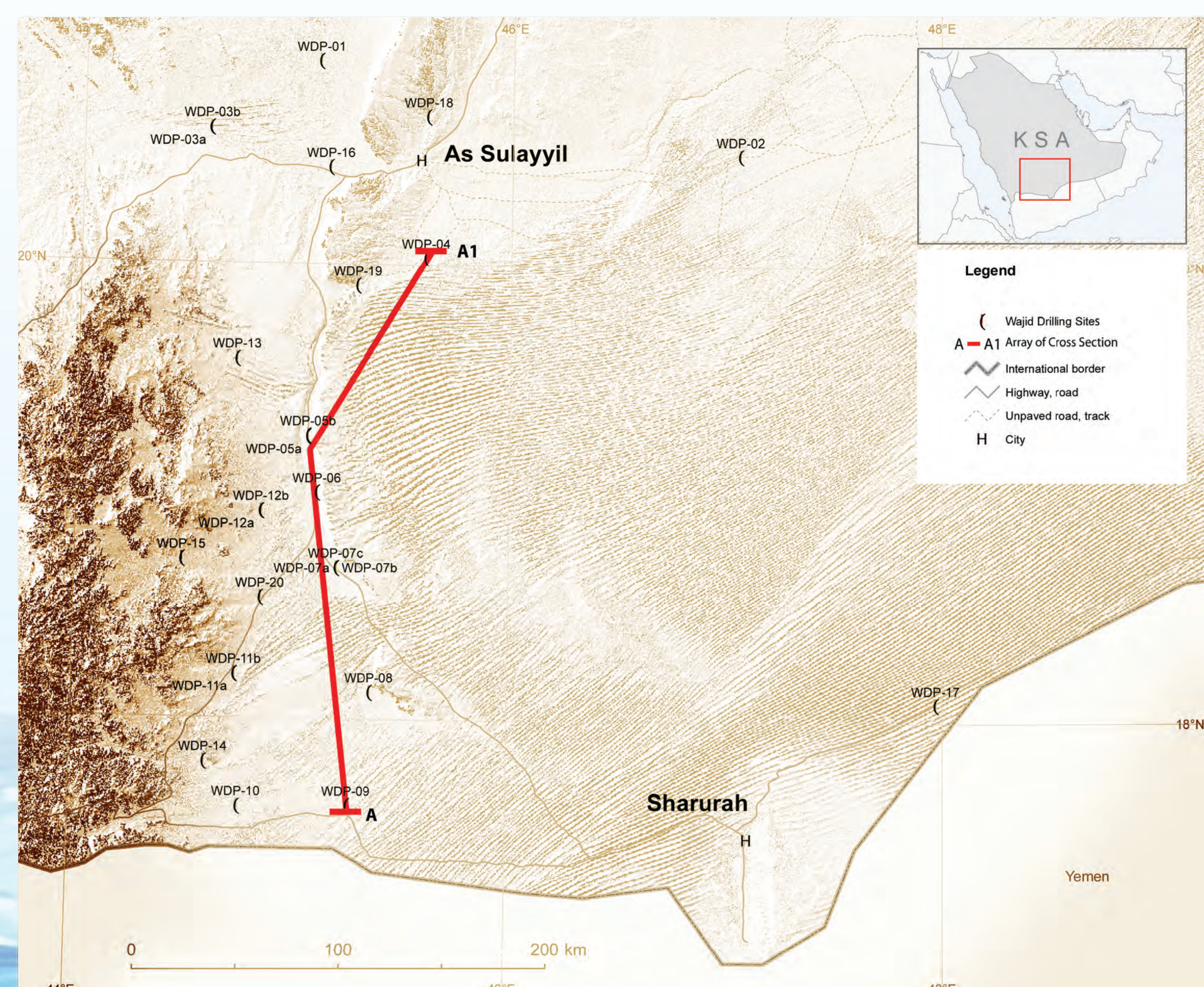


Fig (1). Geological and corresponding hydrostratigraphical units of the Wajid Sandstone (After GIZ 2009 with some modifications)

DRILLING CAMPAIGN

The main objective was to obtain the basic knowledge and information of the lithostratigraphical and hydrogeological units of the upper and lower Wajid Sandstone Sequence and the overlying aquifers. The location of the drilling sites is located in the southwest Arabian Peninsula (Fig.2). Two main types of wells were distinguished: Exploration Wells and Observation Wells. Exploration Wells were designed to allow aquifer testing by pumping and future conversion into production wells. The diameter of the pump house casing is 13 3/8" API casing. Observation wells were constructed for more detailed analysis of pumping test and to allow the installation of slim pump (6 inch) for constant test, and subsequent use as permanent observation with monitoring equipment. The pump house casing was selected as 9 5/8" API casing. All the exploratory wells were drilled to the total depth touch the basement rocks

The rotary drilling techniques with direct mud circulation were employed without any drilling fluid additives. Drilling rigs were chosen to drill wells up to 1500m. The rigs deployed were Gardner Denver – George Failing 2000 for wells up to 700m, while Speed Star SS40 and Gardner Denver 3000 were need for wells over 1000m.



(Fig. 2) Location Map

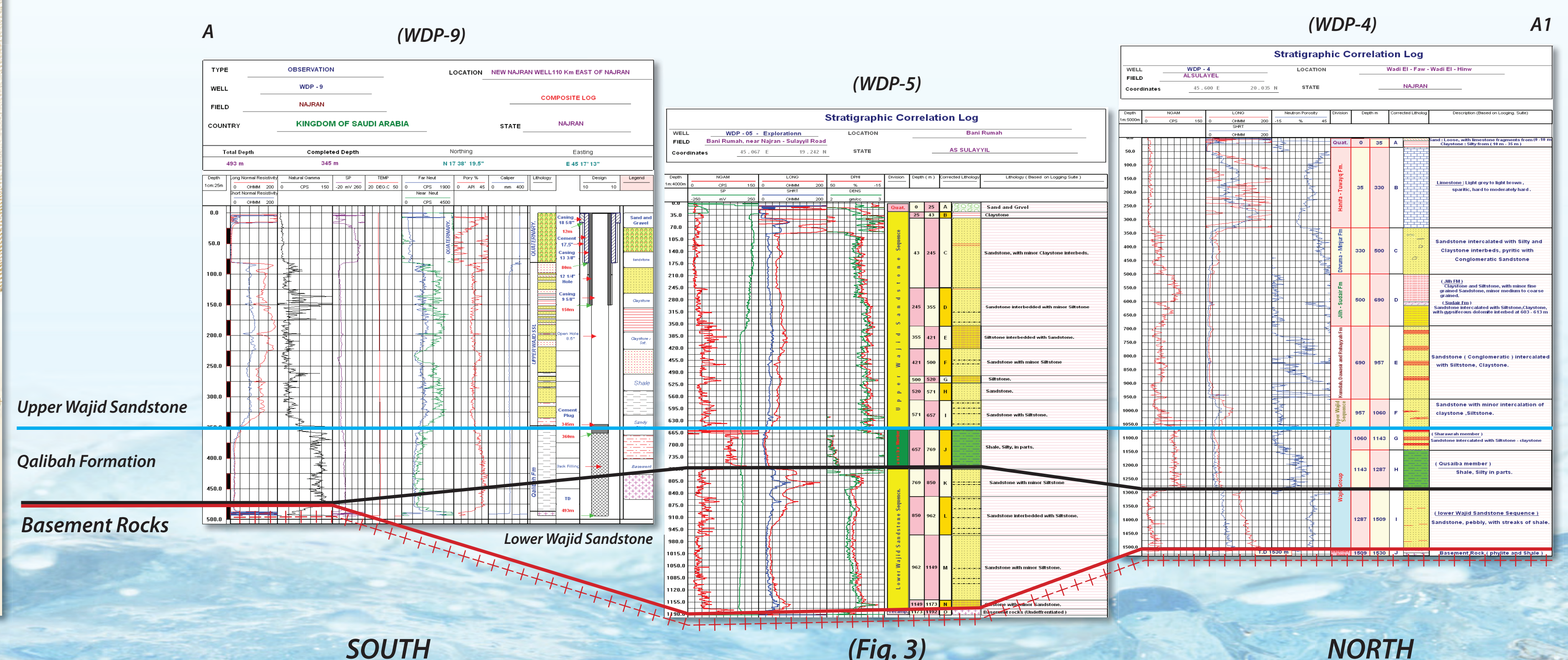
GEOPHYSICAL WELL LOGGING AND WELL CORRELATION

All the exploratory and observation wells were geophysically logged by a modern logging unit of Abu Degen Company (Robertson Geologging UK made). Based on construction status of each borehole various logging runs were conducted during the course of drilling. The parameters were recorded: resistivity (16"-64"), SP, natural gamma, dual neutron (neutron porosity), gamma-gamma (density), 3-arm caliper. At the completion of installation, the casing and cementing, cement bond log and casing collar locator log were performed. Conductivity and temperature logging were conducted after 72 hours of the completion of long duration pumping test.

Based on well logs correlation the lower Wajid, Qalibah and Upper Wajid Sandstone were penetrated in the drilled wells as follows:

Well No.	Total Depth (m)	Depth Touched Wajid Units (m.b.g.l)		
		Lower Wajid Sandstone	Qalibah Fm.	Upper Wajid Sandstone
WDP/04	1530	1508 -1303	1303 -1041	1041 - 899
WDP/05	1192	1184 -773	773 - 660	660- 159
WDP/06	1210	1205 - 829	829 - 663	663 - 160
WDP/07a	1182	1179 - 782	782 - 577	577 - 68
WDP/08	1031	1013 - 925	925 - 690	690 - 41
WDP/09	492	-	482 - 348	348 - 81
WDP/011a	366	360 - 305	305 - 180	180 - 19
WDP/012a	750	750 - 549	549 - 425	425 - 22
WDP/020a	704	696 - 450	450 - 332	322 - 7

Based on the correlation between wells, the corresponding log patterns of the Wajid units were matched all over the study area. The Lower Wajid Sandstone rests on the basement rocks, while the Lower Wajid and Upper Wajid are separated by the shaly and silty Qaliba formation. The corresponding total gamma ray log patterns are for all WDP wells clearly indicating the three lithostratigraphic divisions of the Wajid Group. (Fig. 3)



(Fig. 3)