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Petroleum Exploration on the Northwest of the Iberian Peninsula during the Spanish Civil War: 1937-1938

Introduction: Historical Petroleum Exploration in Spain and World Oil Production in 1938.

The history of the Petroleum Exploration in Spain from the end of the 19 th century until 1939 is poorly recorded. This period can be divided in two stages, both without commercial oil discoveries:

-From 1860 to 1918. Time marked by technical improvisation.
-From 1918 to 1939 (End of the Spanish Civil War): Stage wit strong intervention of the official companies.

Twenty-nine wells were drilled in Spain from 1894 to 1937 (Alvarado&Cantos, 1941), ranging from a minimum depth of 100 m to 1611 m. They were characterized by an absence of systematic exploration studies and located just close to surface oils seeps, and often with inadequate drilling rigs. Almost 50% of the wells were dry, 31% had some non-commercial oil & gas shows and the remaining (19%) were suspended.

During this period several private and public companies licensed some hydrocarbon investigation concessions. The number and acreage of the concessions are summarised on the table nº1.

At the end of the third decade of the last century Spain had no oil production[1] and the main petroleum imports came from Russia, United States and Romania. In 1938 United States and Russia were the two main oil producers with the 72% of the world production quota. The figure 1 illustrates the world oil production by countries in 1938.

Table nº1.

Year	Nº Concessions	Surface
1923	176	1523 km^2
1924	184	1383 km^2
1925	144	773 km^2
1926	111	689 km^2
1927	96	586 km^2
1928	128	554 km^2
1929	130	384 km^2
1930	115	356 km^2
1931	105	238 km^2
1932	123	156 km^2
1933	135	135 km^2
1934	79	93 km^2
1941	11	33 km^2

[1]The first hydrocarbon commercial field in the onshore of Spain was discovered in 1964 (Ayoluengo, Burgos province).

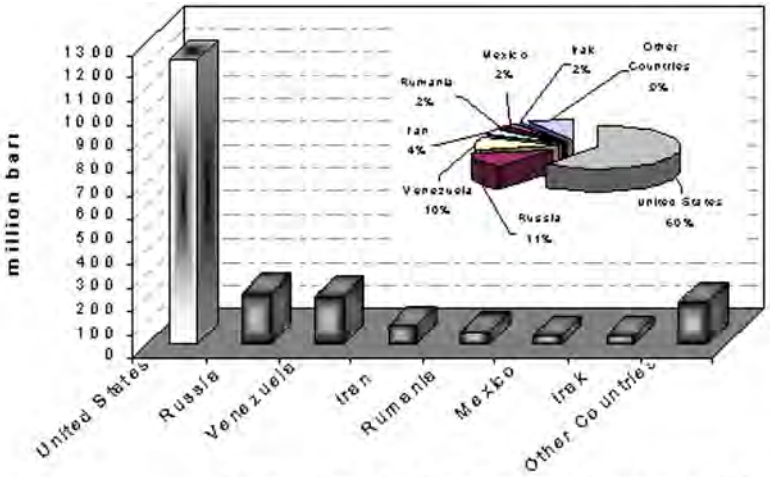

Figure 1. Simplified World Petroleum Prodution in 1938

The Spanish Civil War 1936-1939.

The Rebel uprising on July 18th, 1936 was the beginning of the Spanish Civil War. This uprising was unsuccessful in many provinces of the north of Spain with many areas being initially controlled by the Republican troops.

During the last days of March 1937, Franco took an important decision for the development of the war. He decided to decrease the direct offensive for the conquest of Madrid[2] and concentrate the main attack on the Republican Norwest of Spain. In October 1937, after several battles and due to the Italian and German military aid, all of the northern Spain was in Rebel control.

Petroleum Exploration on the northwest of Spain 1936-1937.

From the last months of 1937 until the end of the Civil War several petroleum exploration campaigns were carried out by CAMPSA[3] (Compañía Arrendataria del Monopolio de Petróleo S.A), which was reactivated in Burgos by a specific Franco´s law (August 12, 1936). These exploration field projects covered Navarra, Alava, Soria, and Burgos provinces. Some of these locations were sites of the previous military operations in 1937. Mining Engineers from *IGM* (Instituto Geológico y Minero) were commissioned by *CAMPSA* (Spanish public company) to carried out petroleum exploration activities in the North of Spain, over Mesozoic-Cenozoic Vasque-Cantabrian Basin in 1937-1938 .The names of these Mining Engineers were Alfonso del Valle and Alfonso Alvarado.

Petroleum Exploration in Spain (1937-1938): Methodology and Campaigns.

The Exploration methodology carried out by the Geologists and Mining Engineers in Spain in the period 1937-1938 was divided in two steps. These were:

.1. Prospection and Mapping:
Outcrop Geological Analysis: Oil seeps, Reservoir characteristics, presence and quality of seal, etc… They also used the shallow testing holes to delineate structural conditions in areas where outcrops were scarce or absent.
Map generation: Structural and Reservoirs Map, which incorporated oil seeps information were produced and used in conjunction with Cross-sections.
.2. Selection of a drill hole site:

[2]The Madrid offensive had begun in October 1936.

[3]Created by the Primo de Rivera´s government in June 28, 1927.

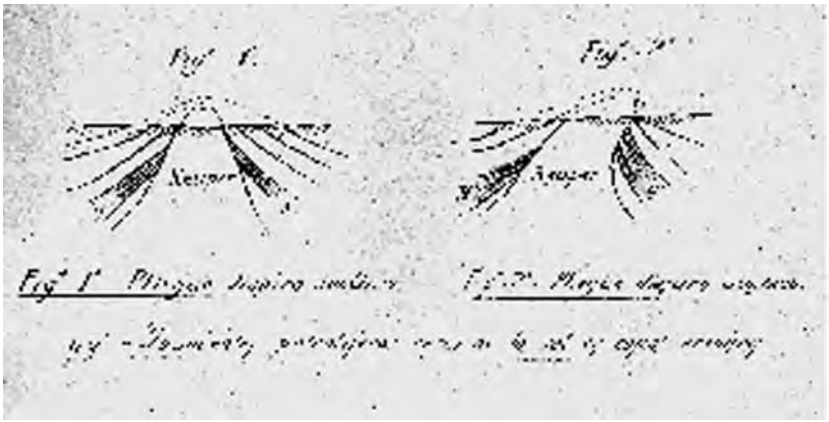

Figure 1. Example of potential traps in diapirs, used as a exploration concept in Spain in 1937.

The exploration staff used a simplified and empirical petroleum system related concept. They used several elements which synthesized the know-how of the exploration using, at the same time, as analogs the oil fields of Romania, Azerbaijan, Iran and the United States. In this text we kept the same terminology used in 1937-1938.

Source Rocks or Primary deposits: At this time mainly defined by the oil seeps. The general theory was that the best source rocks were the facies originated in brackish sea or lagoons.
Receiver Rocks (=Reservoirs): Rocks with appropriate Porosity and Permeability (or fracture network).
Cover Rock (=Seal): Characterized by its impermeability.
Tectonic elements that could facilitate migration or trapping (Trap+Migration). See figure 1 as an example.

Two exploration campaigns covered areas that were sites of the military operations only two month ago. In fact, planning of the exploration was made out in June of 1937, when some selected areas, north of Burgos province, were still controlled by Republicans troops. Nevertheless the Rebels conquered theses areas in August of 1937 and the exploration programme started at the end on September of 1937.

The Exploration campaign consisted in several field trips to recognize geological setting of the Mesozoic-Cenozoic, identification *in situ* of a large number of oil seeps and asphalt mines, and localization of large favourable structures for accumulations of hydrocarbon (anticlines and diapirs flanks). It is important remember that outcrop data was minimum and there was very little well data.

The exploration studies recognized oil seeps and asphalt mines in several places:

-Cretaceous of Irurzun (Navarra) and Salvatierra (Alava).
-Jurassic of Oderiz (Navarra).
. Upper Cretaceous in Alsasua area (Navarra), in Elorrio and Garay (Vizcaya).
. Cretaceous and Jurassic of Peñacerrada-Montoria-Loz area (Alava).
. Siliciclastic Cetaceous sandstones of Maeztu, Atauri y Leorza (Alava), etc. In this area Gastiain well had been drilled by Compañía Petrolera Ibero-Americana in 1923 which reached a total depth of 1611 m at Cenomaniense and had gas shows in several horizons.

Additional exploration programs covered areas of the Iberian range in Soria Province, and several oil seeps was recognized in Lower Cretaceous siliciclastic rocks.

The most important exploration effort was centred in the north of Burgos province, and exploration campaign was carried out with more detail than others zones. Only two deep wells had been drilled in the north of Burgos province 1937 Cubillo del Rojo well promote by Official Authorities in 1923 with total depth of 614 m and Robredo-Ahedo well

by Compañía Petrolera Ibero-Americana in 1924 with total depth of 1009 m where was recovered 70 litres of oil from Weald reservoir

The Main targets in explorations were wide anticline structures and structures relationship with salt diapir. Exploration studies identified several structures as Zamanzas Anticline, Leva Anticline, Huidobro Anticline, San Cristóbal Dome, Tesla Anticline, Dobro Anticline… etc. Also several oil seeps and asphalt mines were recognized in Huidobro, Basconcillos del Tozo, Valle Zamanzas (see figure nº2), etc. (Theses oil seeps are usually present in Lower Cretaceous Siliciclastic rocks and Utrillas Formation / Escucha Formation).

Some of theses structures with oil seeps closed by or over the structure were marked as target to drilled, but more detail surveys were carried out in Zamanzas Anticline.

Zamanzas Anticline is a structure with approximately 15 km length and 4 km wide and it is located in a deformed belt. Morphologically is an open anticline, which flanks are the borders of the valley (Upper Cretaceous Carbonates rocks). The nucleus of the anticline is centre of the valley and Siliciclastic sediment from Lower Cretaceous in Facies Weald.

Facies Weald comprised of siliciclastic sandstone and mudstone and with strong oil seep. During the exploration in 1937-1938, structures in the nucleus of the Zamanzas Anticline were investigated for localization of deep exploration wells.

Conclusions.

Just few weeks after the Republican defeat on the Northwest of Spain, the Franco´s government authorized several small petroleum exploration campaigns on that area. The exploration methodology was exclusively based on geological outcrop analysis, with the aid of some conceptual elements[4] (Source Rocks+receiver Rocks+Cover Rocks+Structures) that resumed the know-how of the epoch.

Some leads recognized in the exploration programs (1937-1938) were proposed for drilling in the Burgos province. In some cases these structures were drilled within a few years; that was the case of the wells Zamanzas-1, Zamanzas-2, Zamanzas-3, Peña Ortum-1 and Tudanca 1 drilled in the following decade. Strong oil and gas shows were recognized in few wells; although none of them proved to be commercial discoveries.

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[4]That could be defined as an antecedent of the Petroleum Systems theory.

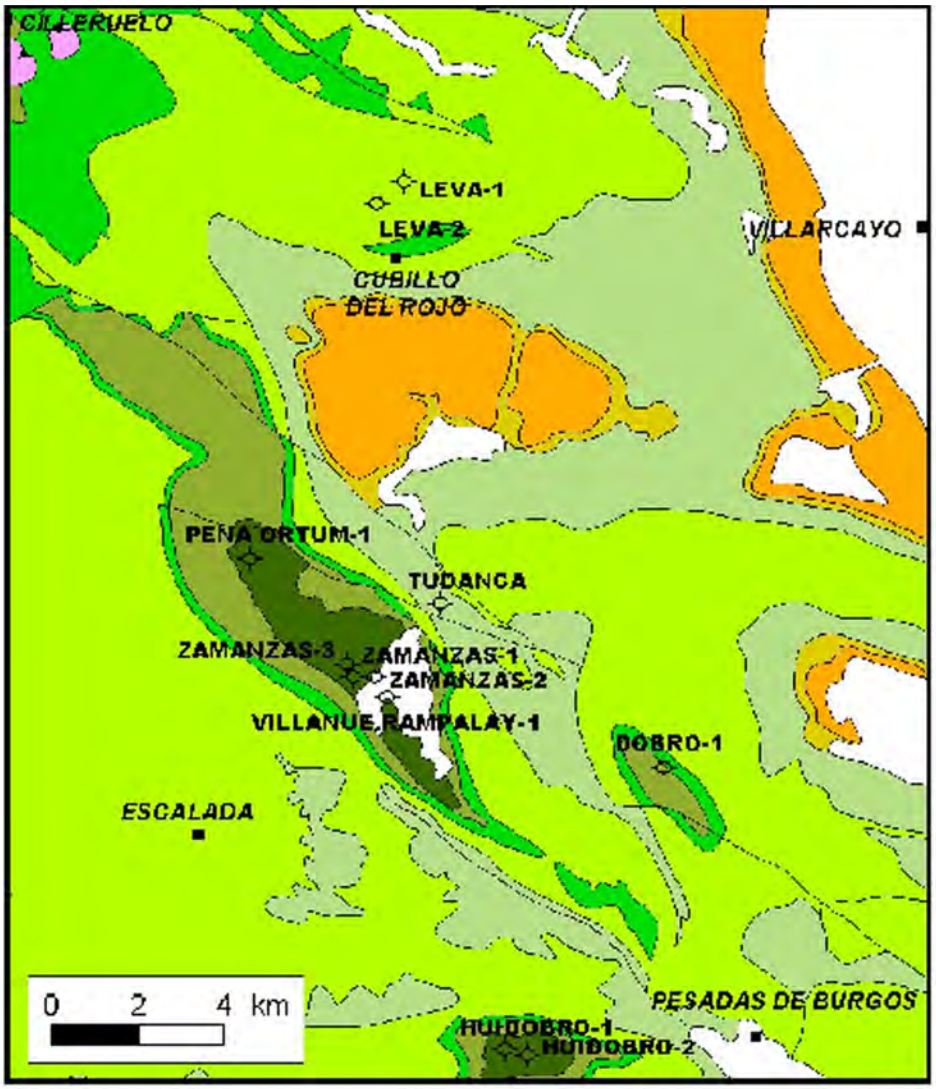

Figure nº3. Geological Map of the Zamanzas Valley (Burgos, SPAIN) where two exploration campaigns were driven in 1937-1938. It includes the locations of the wells drilled between 1940 and 1960.