Peruvian Petroleum System Assessment with a focus on Offshore Basins

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The answers to key issues facing exploration companies acquiring new concessions or assessing charge risk for a lead or prospect can often be found in the geochemistry of oils. Since oils are the compositional derivatives of their source(s), they carry important information about the character and thermal history of the source rocks which would otherwise be unattainable. Today, oil geochemistry is a fundamental component of successful exploration programs in mature or in frontier areas. It is an excellent way of identifying and delineating petroleum systems present in a region (Schiefelbein and Requejo, 2002). One example of applied petroleum geochemistry was a 2006 project funded by a Technical Assistance grant from the U.S. Trade Development Agency (USTDA) undertaken for PeruPetro S.A. A specialized petroleum database was developed and petroleum systems defined as a means to generate renewed interest in hydrocarbon exploration in Peru. The end result allows potential energy investors access to key hydrocarbon exploration information via a web-enabled portal. This project required development of new technologies and approaches to provide potential energy investors access to key hydrocarbon exploration information via a web-enabled portal. It also required experienced geoscientists capable of evaluating and synthesizing large volumes of geoscience data into information for decision-making purposes. These diverse technical skills and capabilities were effectively melded to develop a petroleum system tool in support of hydrocarbon development activities.The dataset includes geochemical data from more than 10,000 samples (see Figure 1 for locations) and 50+ gigabytes of structured and unstructured information from regional studies, operator data reports, open literature and other sources.

The regional petroleum systems active both onshore and offshore Peru were evaluated by first determining the number of effective source units within a region by establishing the number of compositionally distinct oil families. This was achieved through the use of multivariate statistical techniques such as principal component and hierarchal cluster analysis (Schiefelbein, et al., 2002). The chemical attributes of these oil families has been used to determine the stratigraphic and aerial distribution of the source(s), source age, lithology, organic input, thermal maturity and depositional environment. In addition, the extent of the petroleum system can be approximated because their limits are defined by the limits of secondary migration. Areas with overlapping petroleum systems can be identified in relation to possible oil mixing from two or more sources (Schiefelbein, et al., 1996). Processes active in a basin that act to modify the original oil composition can also be assessed. Because oil properties (quality) often determine the economics of exploration on a prospect-by-prospect and/or basin-wide scale, it is imperative to understand controls on oil property and predict them prior to obtaining acreage or drilling.

Geochemical data included in this and similar databases includes results from surface geochemical exploration (SGE) studies (piston coring, soil gas surveys, outcrops) and remote sensing techniques (SAR) that are cost effective means of obtaining information ahead of the drill bit. Application of these techniques can be used to indicate the presence of generative hydrocarbon source rocks, without which there can be no accumulations. In addition, the spatial coincidence of surface slicks or seeps and geologic structure allows for the identification of the loci of natural hydrocarbon seepage and to infer possible migration pathways from the reservoir to the surface. Once the number of compositionally distinct oil types or families found throughout Peru were identified, specific exploration questions were addressed. These include: ‘What are the geographic limits to Cenozoic, Mesozoic and/or Paleozoic oil types?’ or ‘What is the origin of oil slicks detected offshore Peru?’ or ‘How many different oil types are present in the Ucayali Basin and where do they overlap?’ By comparing and contrasting detailed information from potential source rocks, source-to-oil correlations were established and new plays identified. In order to identify the most promising commercial areas and thereby reduce exploration risk, petroleum systems descriptions for each of 17 major sedimentary basins in Peru were generated. This information was fully integrated with geological, geophysical, petrophysical, and modeling results.

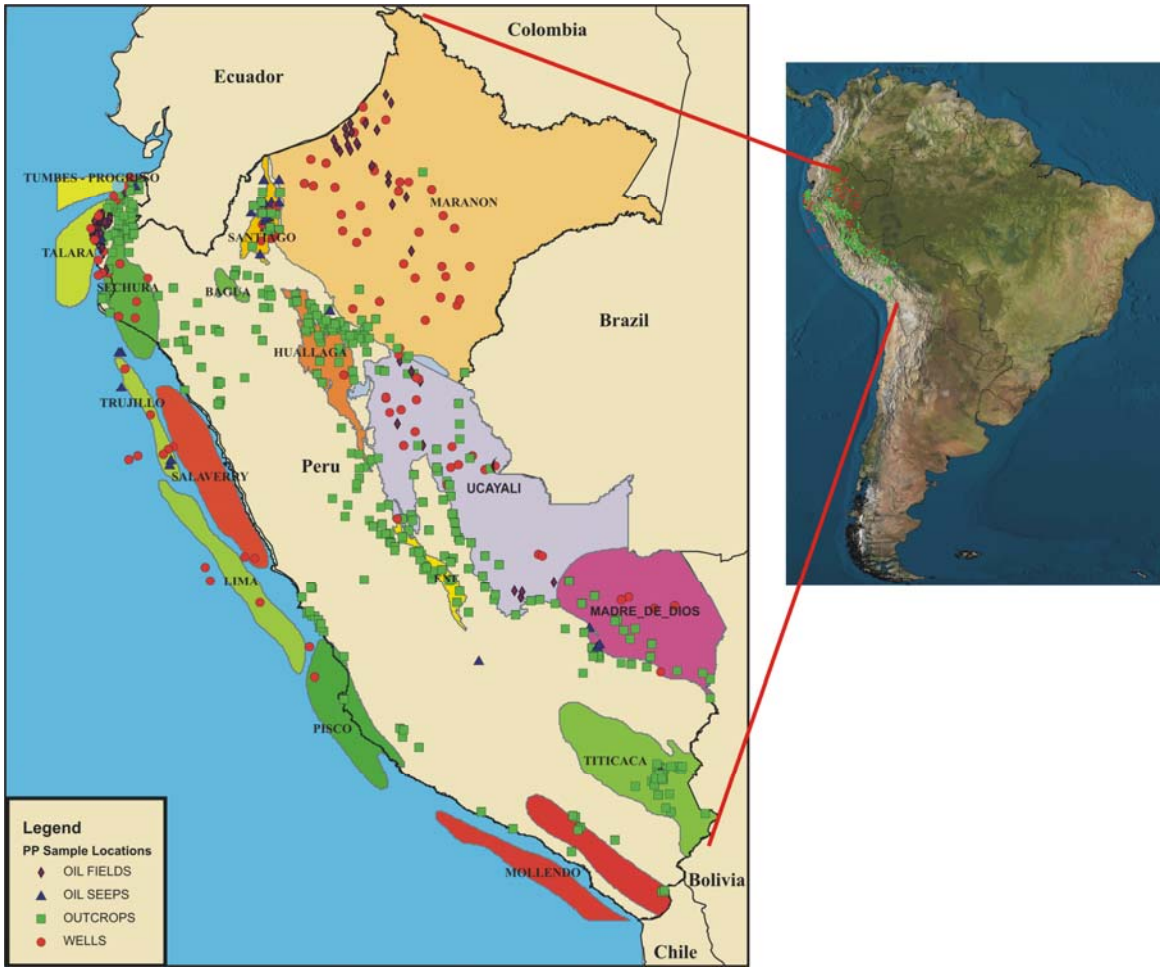

Figure 1. Location of Peruvian crude oil (red), outcrop (green) and seep (blue) samples for which geochemical data are available.

Geochemical data organized in this study suggest that the transition from Cretaceous petroleum systems dominant in northern Sub-Andean basins to petroleum systems having mainly lower Mesozoic or Paleozoic sources occurs in central Peru. Composite petroleum systems were identified that are interpreted to include source rocks of Tertiary (mainly Talara Basin), Cretaceous (Maranon and Santiago basins), Triassic-Jurassic (southern Maranon and northern Ucayali basins), Permian (Ucayali Basin), Carboniferous (Ucayali Basin) and Devonian (Madre de Dios Basin) ages. Available data also suggest that the 'black oil' component of Coastal basin oils originated from Tertiary (Oligocene Heath Formation) source rocks deposited in a marine deltaic environment. These oils may also contain a light oil component derived from source rocks of Albian age. Ancillary data providing a better understand of petroleum systems active in the onshore basins are also discussed.

References

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