

# Utilization of Volatile Organic Compounds in Drill Cuttings and Prediction of Favorable Zones Before Well Tests: Examples from Turkey\*

Kadir Gürgey<sup>1</sup>, Alan H. Silliman<sup>2</sup>, Tuba E. Sökmensüer<sup>3</sup>

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<sup>1</sup>Independent Consultant, Ankara, Turkey ([kgurgey@pau.edu.tr](mailto:kgurgey@pau.edu.tr))

<sup>2</sup>Amplified Geochemical Imaging, LLC, Newark, DE, USA

<sup>3</sup>Genel Enerji, Ankara, Turkey

## Abstract

Prior to well testing efforts of conventional reservoirs, detection of oil rich layers (ORLs), vertical continuity between the ORLs, hydrocarbon types and quality (oil versus gas) has long been done with the use of well log, core sample and drill stem test data. These approaches have been very expensive particularly in offshore areas and in basins where thin (ORL < 2-5m) and multiple or stacked reservoirs are found such as in Gulf of Mexico in USA (Dutton et al. 2012), South Caspian Basin in Azerbaijan (Gürgey, 2003) and Bohai Bay Basin in China (Liu et al. 2014) and Gediz Graben in western Turkey (this study).

The purpose of this study is to introduce a method that helps to decrease the expense, shorten the decision time and to accurately select the test intervals prior to well testing. The method utilizes volatile organic compounds (VOCs) and semi-VOCs (SVOCs) present in drill cuttings (Anderson, 2006). Initially, each cutting sample is subjected to passive treatment with an Amplified Geochemical Imaging (AGISM) module that contains unique adsorbents to adsorb 88 different VOC and SVOCs within the range of n-C<sub>2</sub> to n-C<sub>20</sub>. Each AGISM module is then analyzed by thermal destruction/gas chromatography/mass spectrometry (TD/GC-MS) to detect VOCs and SVOCs in qualitative and quantitative manner (in a nanogram level). Consequently, 45 oil-like hydrocarbons were selected and used for the purpose of this study.

Three hundred and thirty-three drill-cutting samples were cautiously collected along Sarikiz-2 (122) and Sarikiz-3 (211) wells from the Alasehir area in the Gediz Graben of western Turkey. The cuttings were treated with the method just described above. The data belonging the two wells were evaluated separately as in two matrixes (Sarikiz-2:122X45 and Sarikiz-3:211X45) using conventional as well as score and loading plots derived from principle component analysis. Obtained results were as follows:

- 1) Fluid typing and quality: The Sarikiz-2 has good quality light oil with significant amount of dissolved gas,

- 2) ORLs: The Sarikiz-2 well showed eighteen different ORLs below 1,500m. In contrast no, ORLs were determined along the Sarikiz-3 well,
- 3) Test ranking: ORLs along the Sarikiz-2 were ranked based upon the total oil-like VOC+SVOC content in 'ng' level. The ranking were compared to true perforation test ranking. Results were excellent.
- 4) Vertical continuity/compartments: Principle component analysis was successfully applied to the matrix (24 ratio parameters in the C<sub>2</sub>-C<sub>20</sub> range X 18 ORLs) to examine the vertical continuity and
- 5) Seal capacity: Extremely low concentrations of VOCs and SVOCs on the top of 1,500 m of the Sarikiz-2 well were observed. This is most likely an indicator of existing of an efficient seal on top of the ORLs. In contrast, the Sarikiz-3 well presents considerable amount of dispersed VOC and SVOCs hydrocarbons on the top of 1,500 m suggesting a lack of efficient seal in this well. Presence and absence of efficient seals were supported by the well log and by the mud log unit-MLU data.

Finally, comparison of the test intervals determined by using AGISM modules to those determined by using well logs and their true perforation test results suggest that the method is very powerful to detect thin sandstone ORLs and very useful when used together with the well logs and MLU.

### **References Cited**

Anderson, S.H., 2006, Amplified geochemical imaging: an enhanced view to optimize outcomes: First Break, v. 24, p. 77-81.

Dutton, P. S., G.R. Loucks, and J.R. Day-Stirrat, 2012, Impact of regional variation in detrital mineral composition on reservoir quality in deep to ultradeep lower Miocene sandstones, western Gulf of Mexico: Marine and Petroleum Geology, v. 35, p. 139-153.

Gürgey, K., 2003, Correlation, alteration, and origin of hydrocarbons in the GCA, Bahar, and Gum Adasi fields, western South Caspian Basin: geochemical and multivariate statistical assessments: Marine and Petroleum Geology, v. 20, p. 1119-1139.

Li, Q., Z. Jiang, K. Liu, C. Zhang, and X. You, 2014, Factors controlling reservoir properties and hydrocarbon accumulation of lacustrine deep-water turbidites in the Huimin Depression, Bohai bay Basin, East China: Marine and Petroleum Geology, v. 57, p. 327-344.

# UTILIZATION OF VOLATILE ORGANIC COMPOUNDS IN DRILL CUTTINGS and PREDICTION of FAVORABLE ZONES BEFORE WELL TESTS: EXAMPLES FROM TURKEY

by

**Kadir Gürgey\*, Alan H. Silliman\*\*, Tuba E. Sökmensüer\*\*\***

\*Independent Consultant, Ankara, Turkey

\*\* Amplified Geochemical Imaging, LLC, Newark, DE, USA

\*\*\* Genel Enerji, Ankara, Turkey

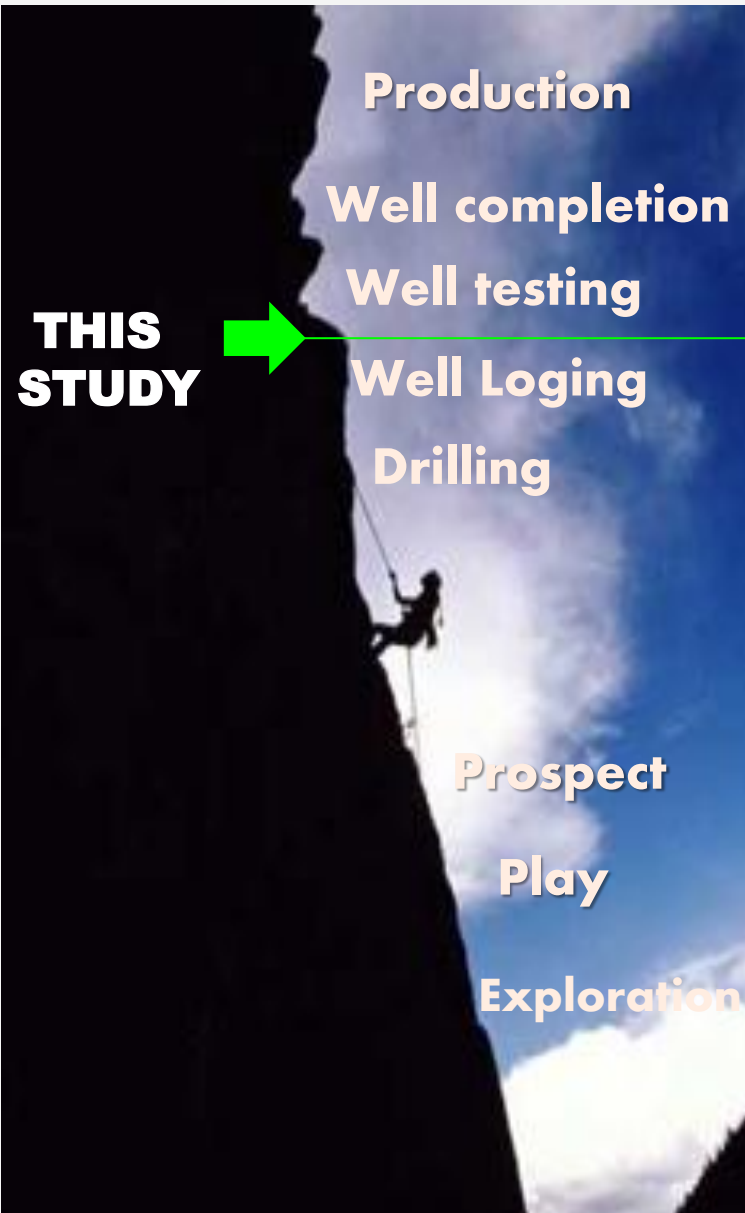
# Acknowledgement

Appreciations are given to those who kindly contributed and supported this study.

**Amplified Geochemical Imaging LLC** sponsoring me to participate this meeting and let this paper present.

**Müjdat İşçi**, from **Merty Energy** collecting drill cuttings.

# Why did we conduct this study?



## Prior to well testing

- oil rich layers
- Compartments
- Fluid types
- Ranking



WELL LOGS, DST, RFT, PERFORATION, CORING



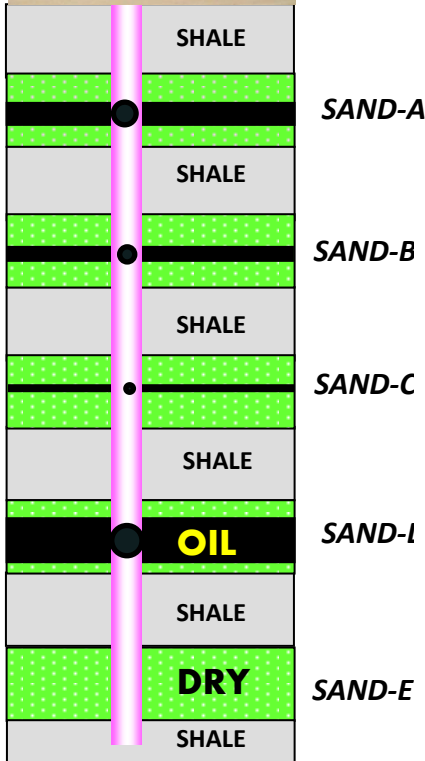
## Some problems

- In thin sand/shale bed sequences  
[Gulf of Mexico, SC, Bohai etc.]
- Expensive in onshore & offshore



**Therefore, any additional robust information is still needed before well tests.**

# Purpose



**Stacked-Shale/Sand  
HC Rich Zones**

- Such information which we believe is present in drill cuttings and can be obtained by using **Amplified Geochemical Imaging [AGI<sup>SM</sup>]** modules.

so, the purpose of this study is to show you how

**Amplified Geochemical Imaging [AGI<sup>SM</sup>]** is a profitable tool to extract unique information from drill cuttings before well testing.

# Talk outline

- Introduction
- Application of AGI to Alaşehir wells
  1. Oil rich layers (ORLs)
  2. Compartments & fluid typing
  3. Seal Capacity
  4. Ranking of ORLs
- AGI vs E-log comparison
- Conclusions

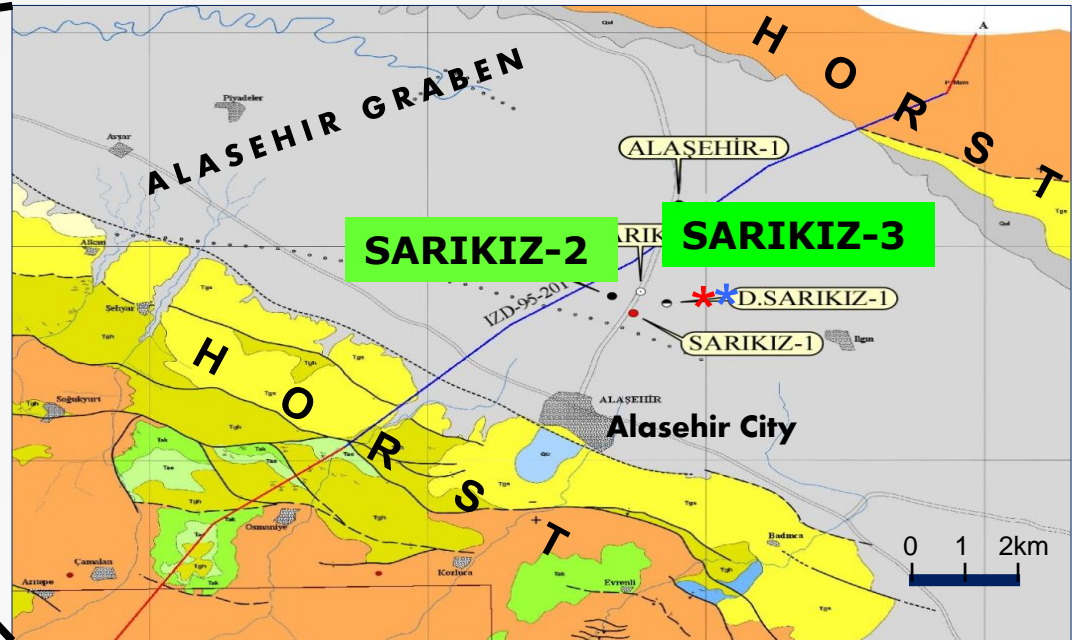
# Geology



## Stratigraphy

	AGE	MIOCENE		FORMATION	THICKNESS(m)	LITHOLOGY
		PLIOCENE	QUATERNARY			
PALEOZOIC - MEZOSOIC	MENDERES METAMORPHICS	M. BURDURGALIN - U. SERRAVAL	U. SERRAVALIAN - U. MIOCENE	KALETEPE	100-250 Tm	
		ALAŞEHİR FM.				
		KAVADİBİ M.	HAMAMCIERE M.	500 - 750 m. Tm		
		EYRENLİ M.				
Pzalm		300 - 450 m. Tm				

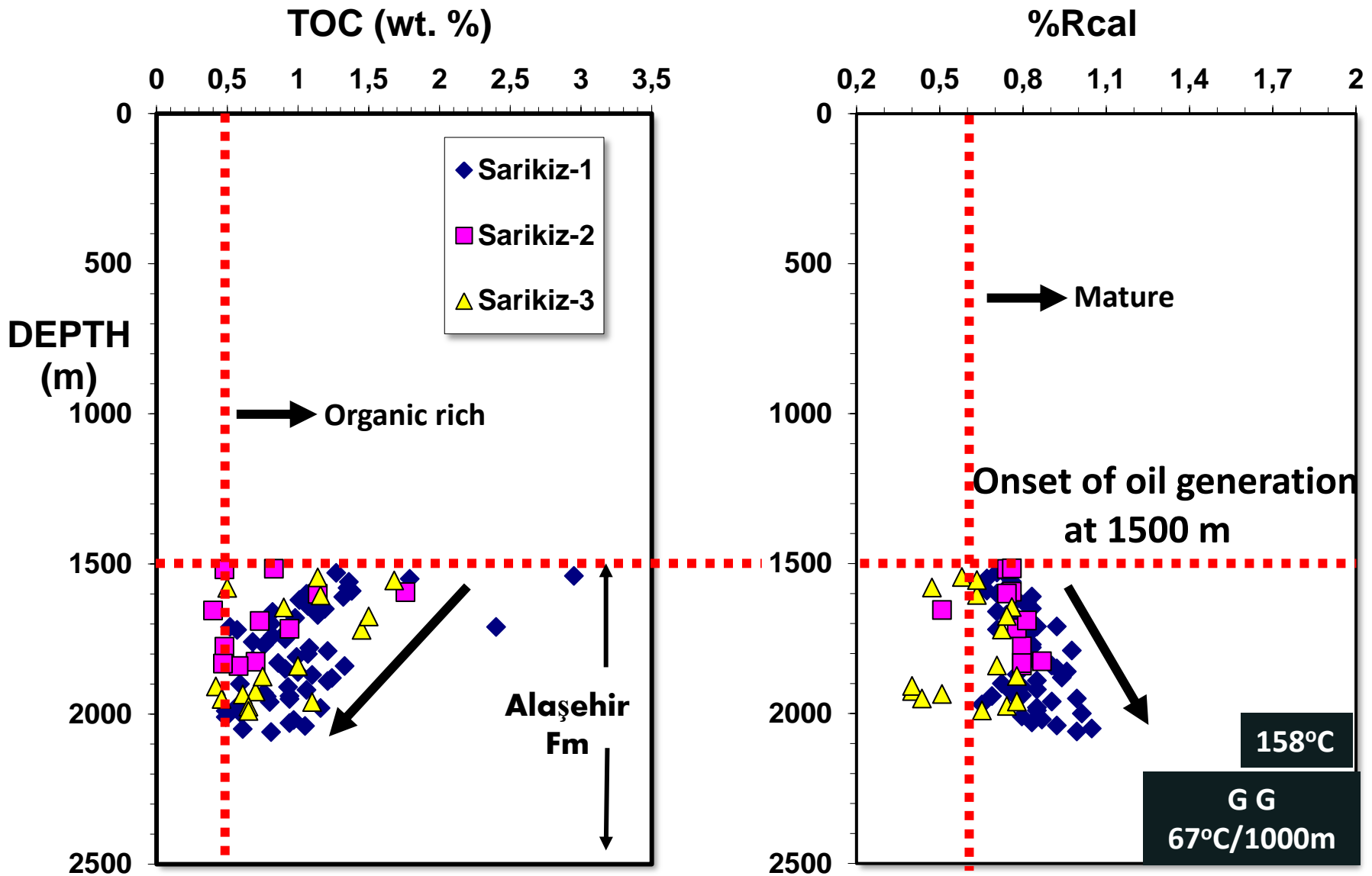
1500 m thick  
Early Miocene  
Alaşehir Fm  
contains oil rich  
thin sand/shale  
layers



## STUDY AREA

- Lacustrine Tertiary clastic sediments reaching up to 3500 m

# Geochemistry



# AGI downhole application

**FIELD WORK** → **AGI NEWARK LABORATORY, DE in USA**



**Mud-Shaker**

- Drill cutting collection from the mud-shaker into the glass jars



**AGI Module**

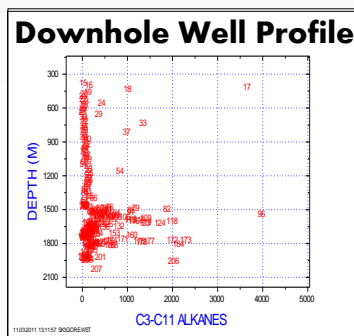
- AGI Module/ Drill cutting passive treatment



**TD/GC-MS**

- TD/GC-MS analysis of the AGI<sup>SM</sup> modules

**REPORT**

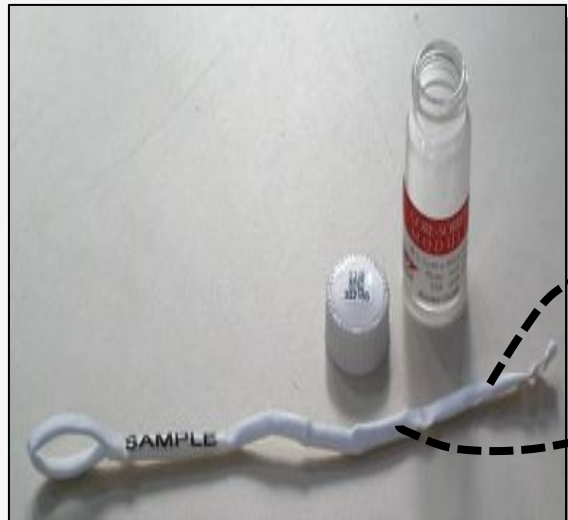


← **INTERPRETATION**

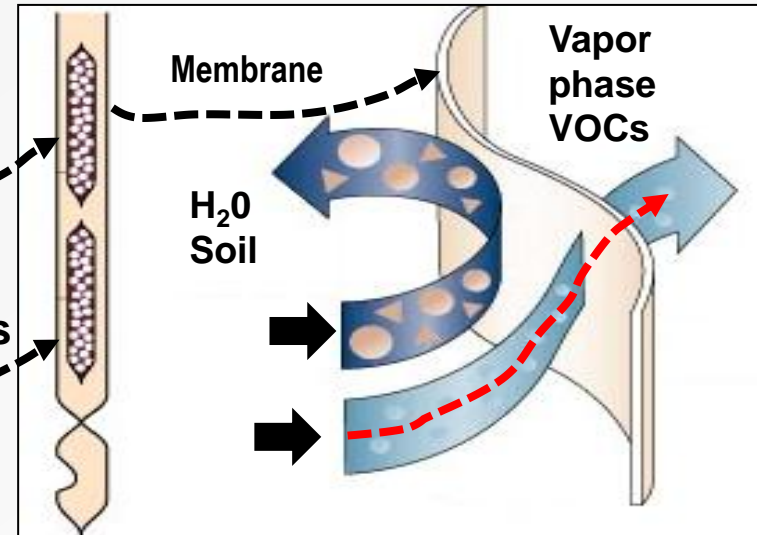


# How does a AGI module work ?

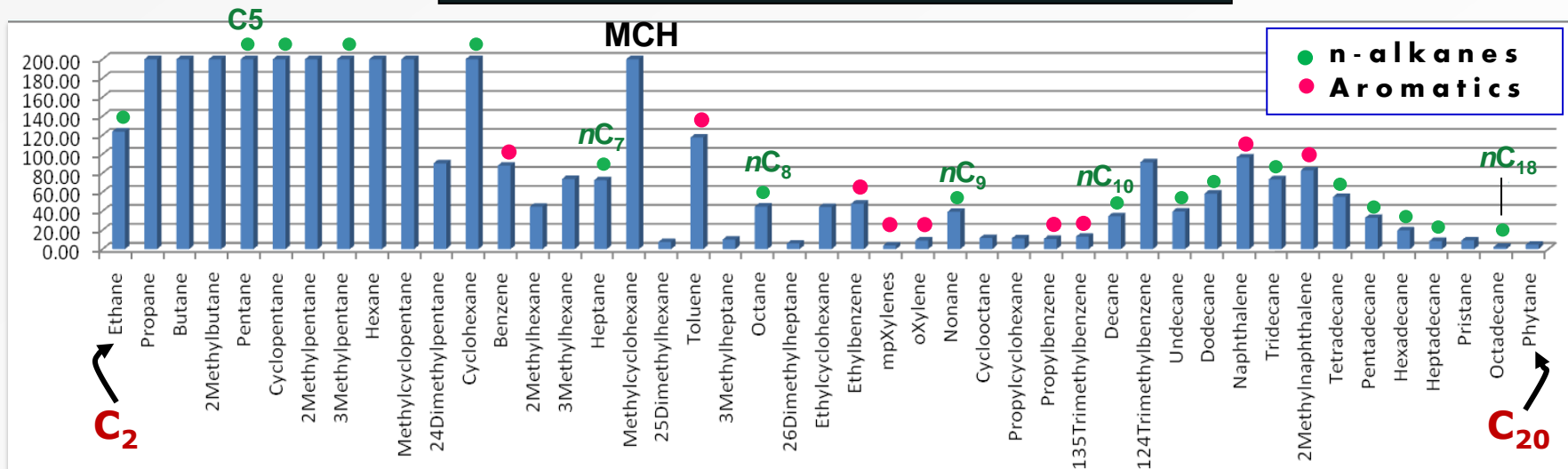
## AGI<sup>SM</sup> Module



## Inside Sorbents



## A typical drill cutting VOC histogram



# AGI application to Alaşehir wells

## SARIKIZ-2 WELL

## SARIKIZ-3 WELL

TD: 1843 m  
Mud type: Water based  
Sample type: Drill Cuttings

2029 m  
Water based  
Drill Cuttings

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Sampling frequency 15 m

15 m 0 – 1463 m  
3m 1464 – 2009 m

Toatal sample number: 122

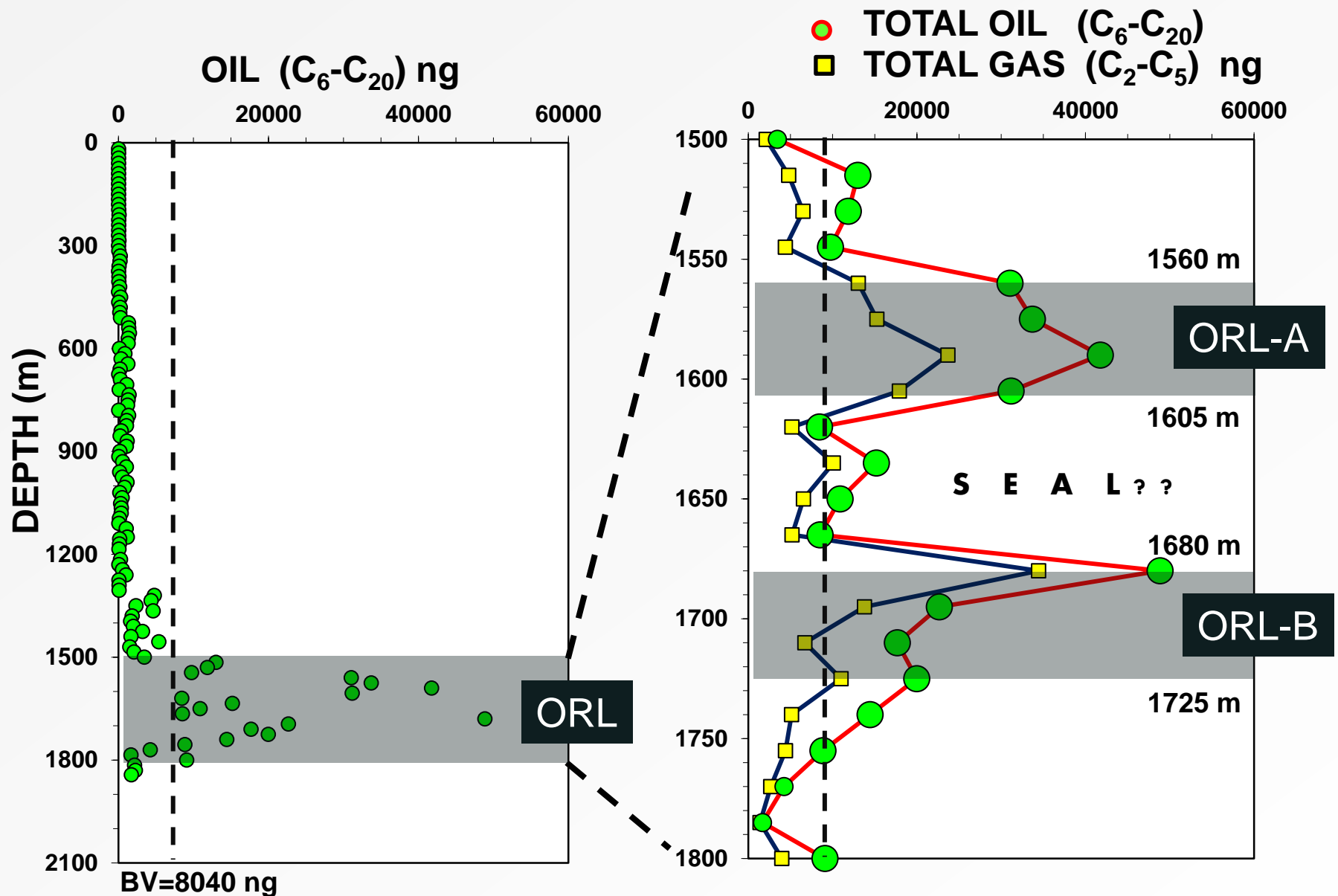
211

- Introduction 1-9

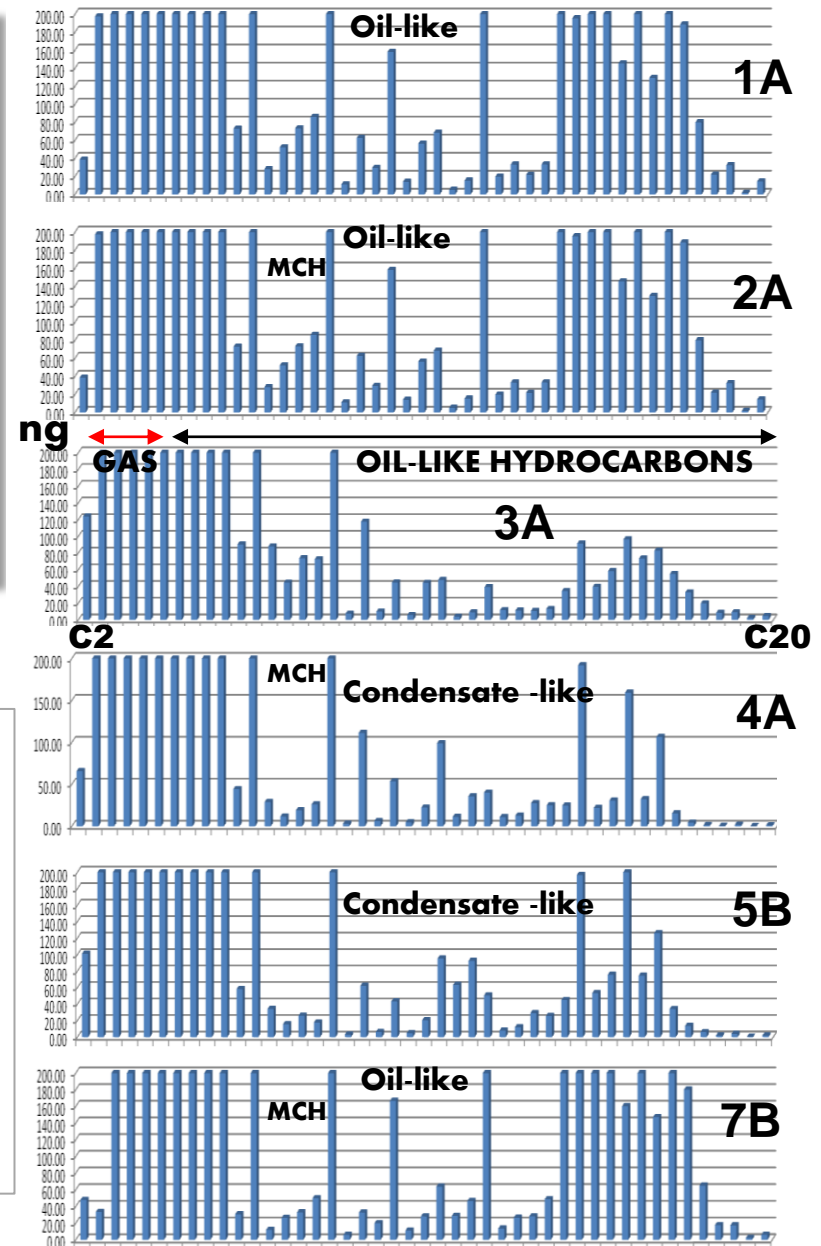
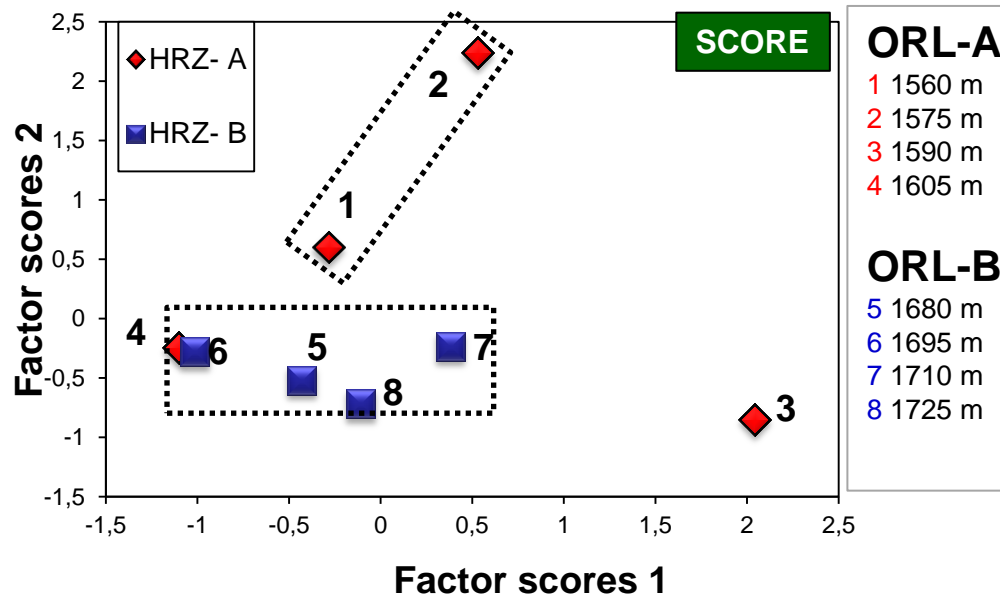
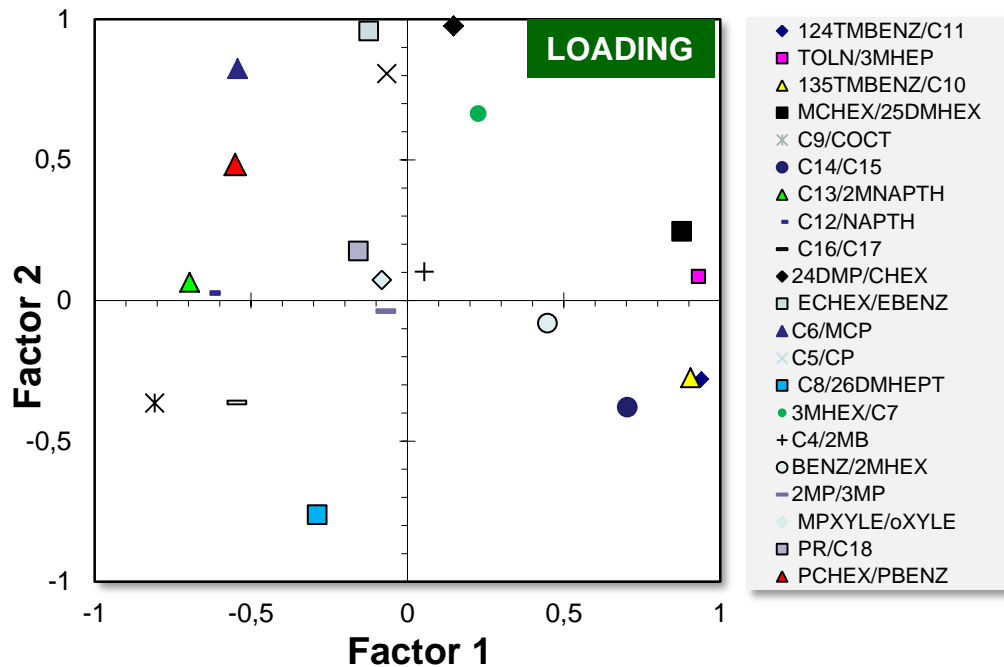
1. Oil rich layers (ORLs) 11
2. Compartment. & fluid typing 12
3. Seal capacity 13
4. Ranking of ORLs 14
5. AGI vs E-Logs 15-16

- Conclusion 17

# Sarıkız-2 Oil rich layers [ORLs]



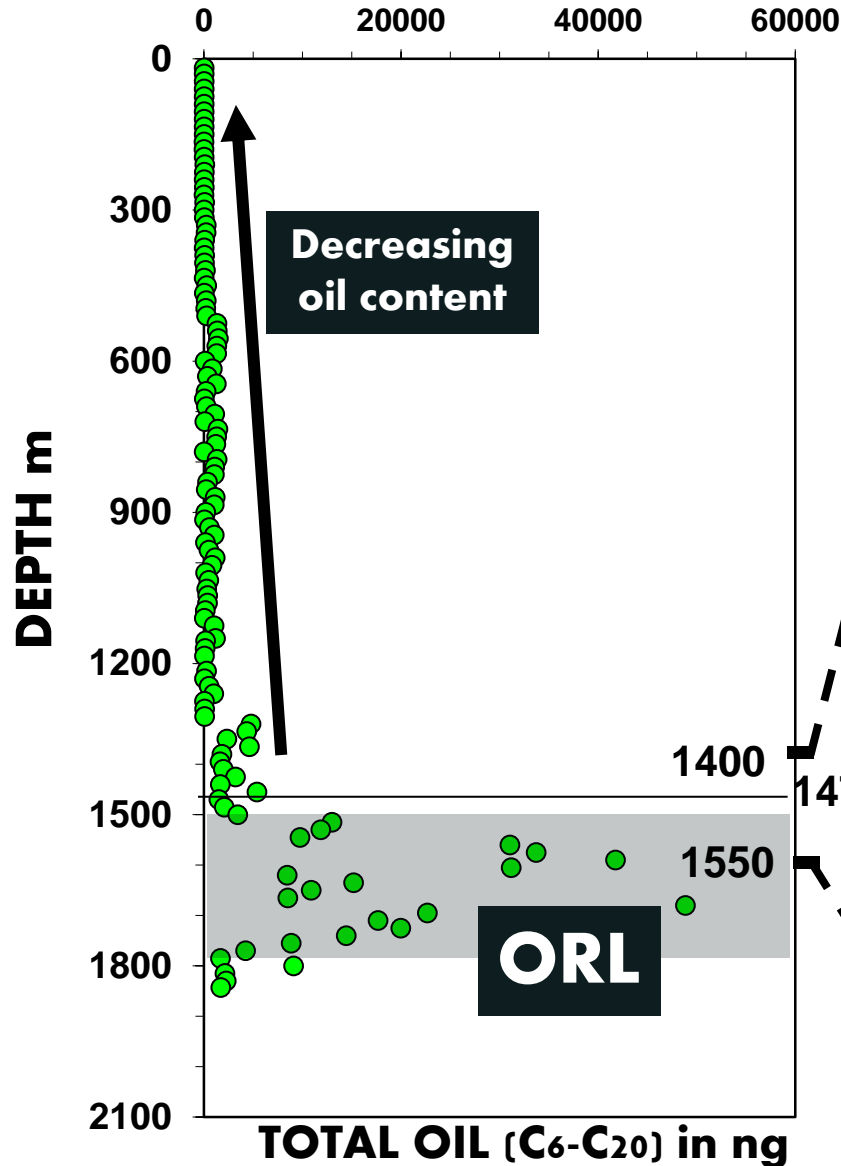
# Compartments and Fluid typing



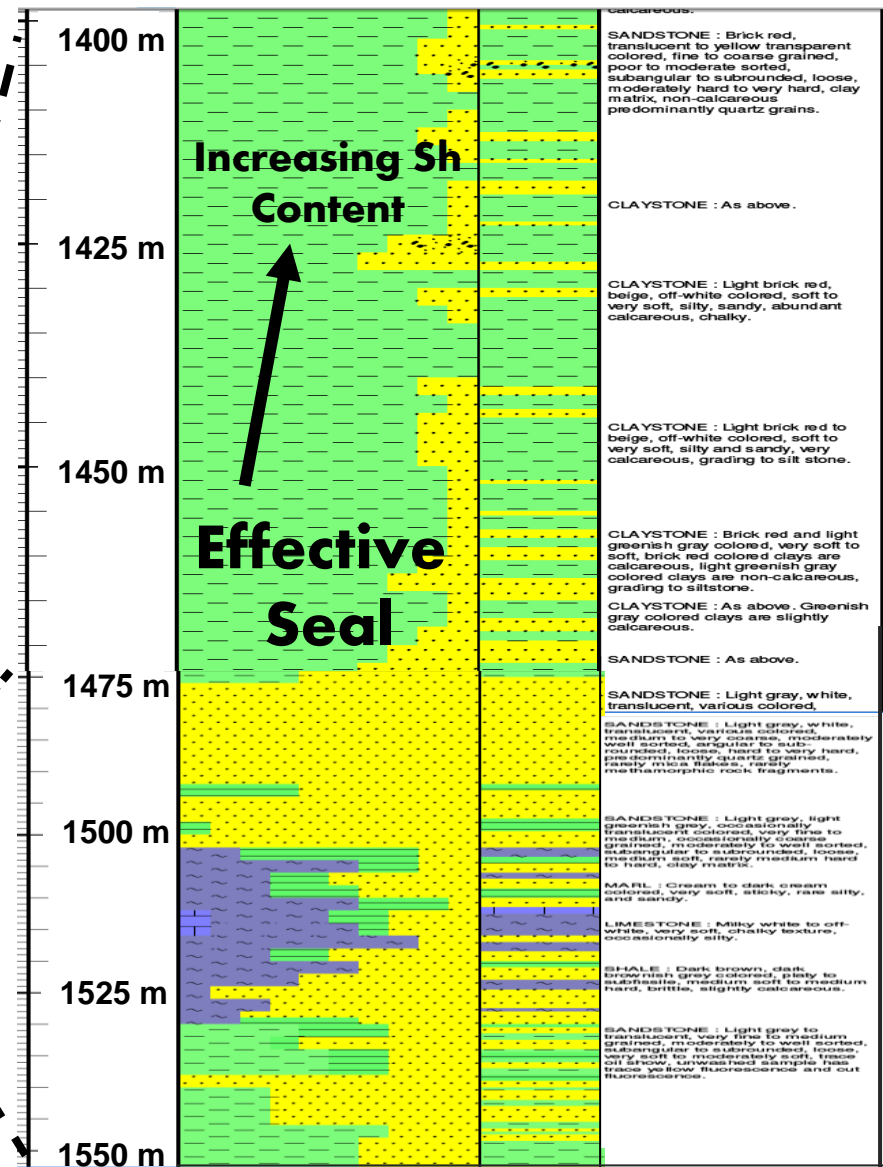
# Sarikız-2

# Seal capacity

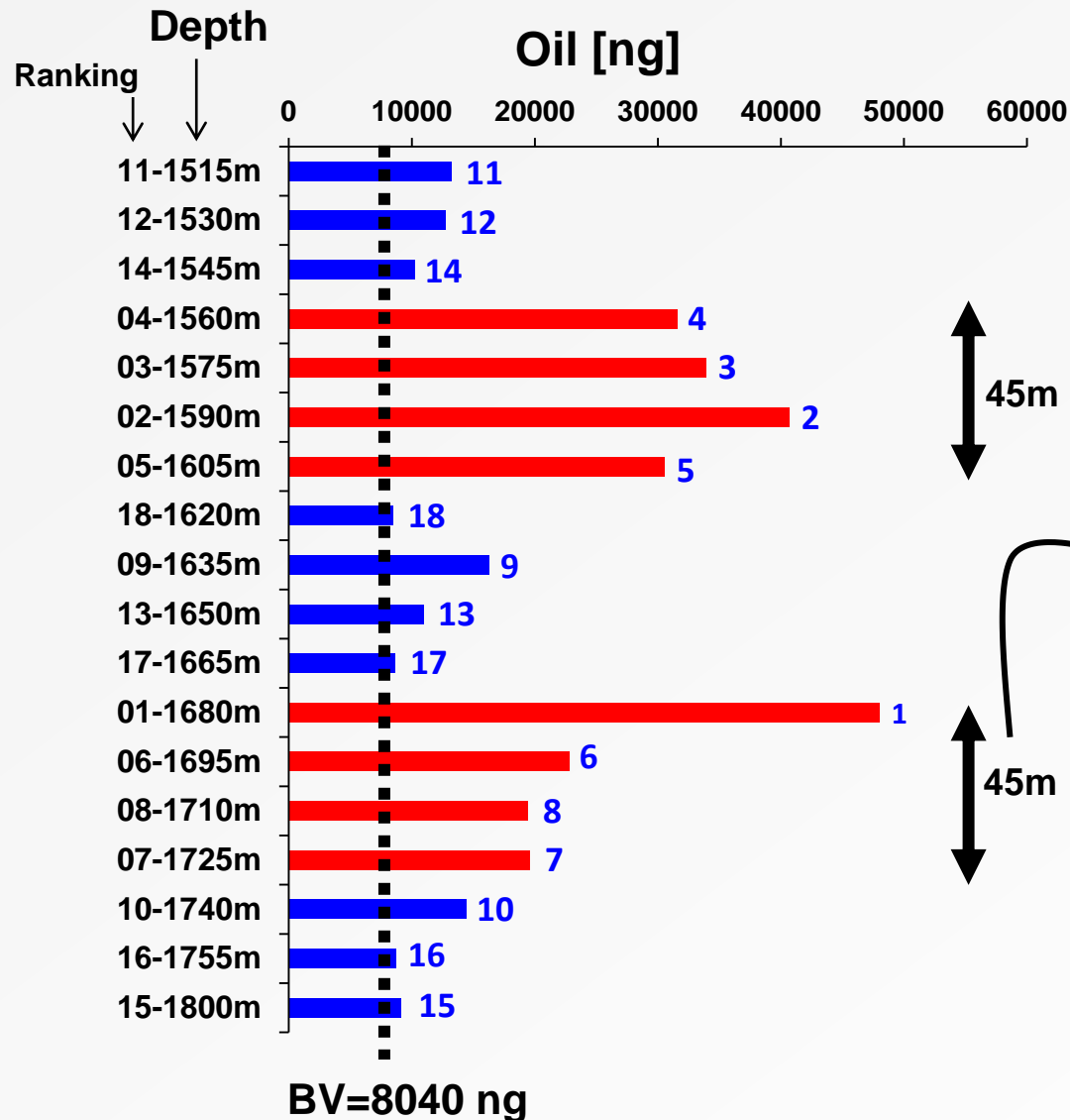
## AGI Data



## Mudlog Data



# Sarıköz-2 Ranking of 18 ORLs for testing



• Ranking is based on the oil content

• **ORL-A 1560-1605m**  
The first preference

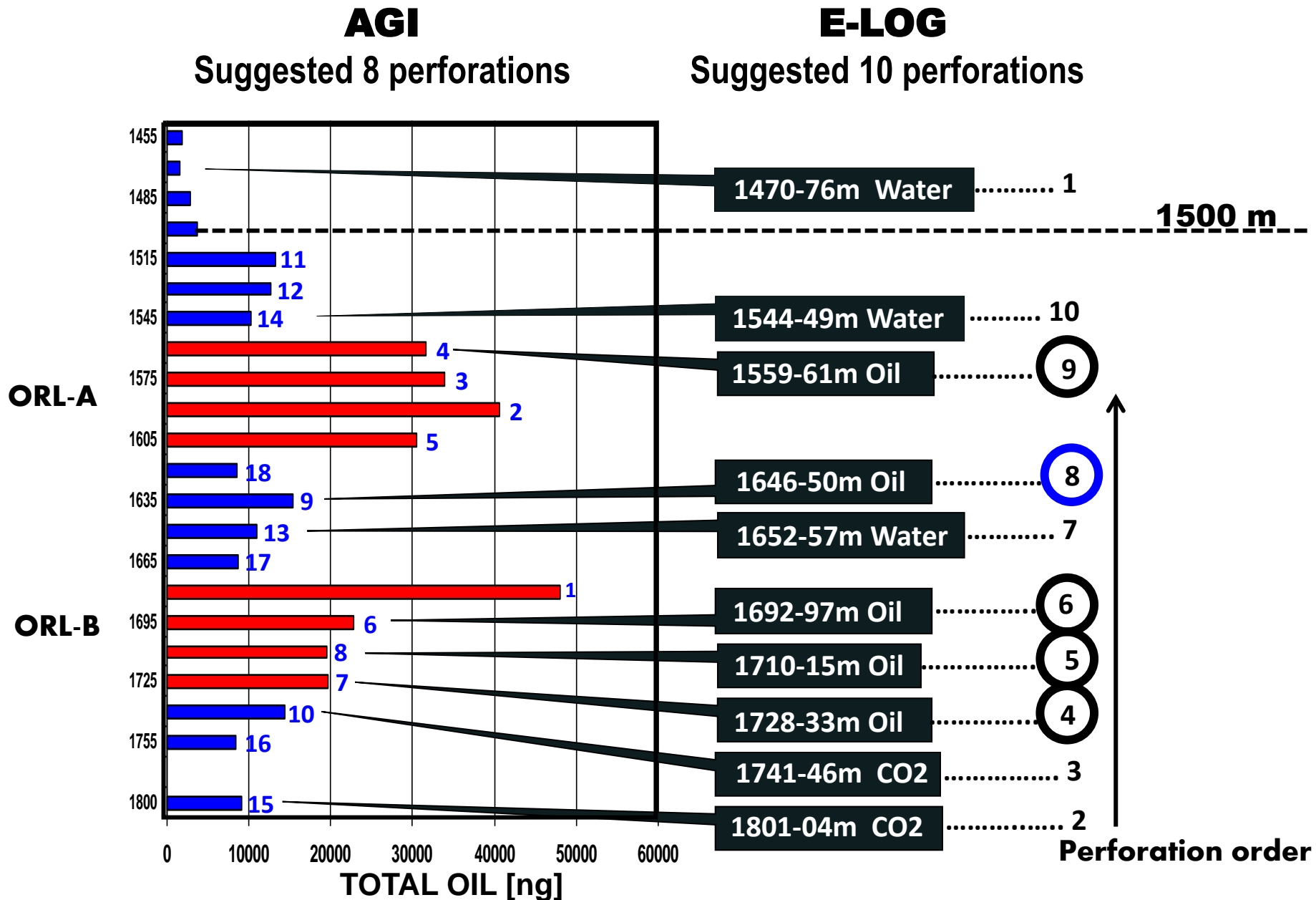
• **ORL-B 1680-1725m**  
The second preference

- Introduction 1-9

1. Oil rich layers (HRLs) 11
2. Compartment. & fluid typing 12
3. Seal capacity 13
4. Ranking of HRLs 14
5. AGI vs E-Logs 15-16

- Conclusion 17

# Sarikiz-2 AGI vs E-Log perforation tests



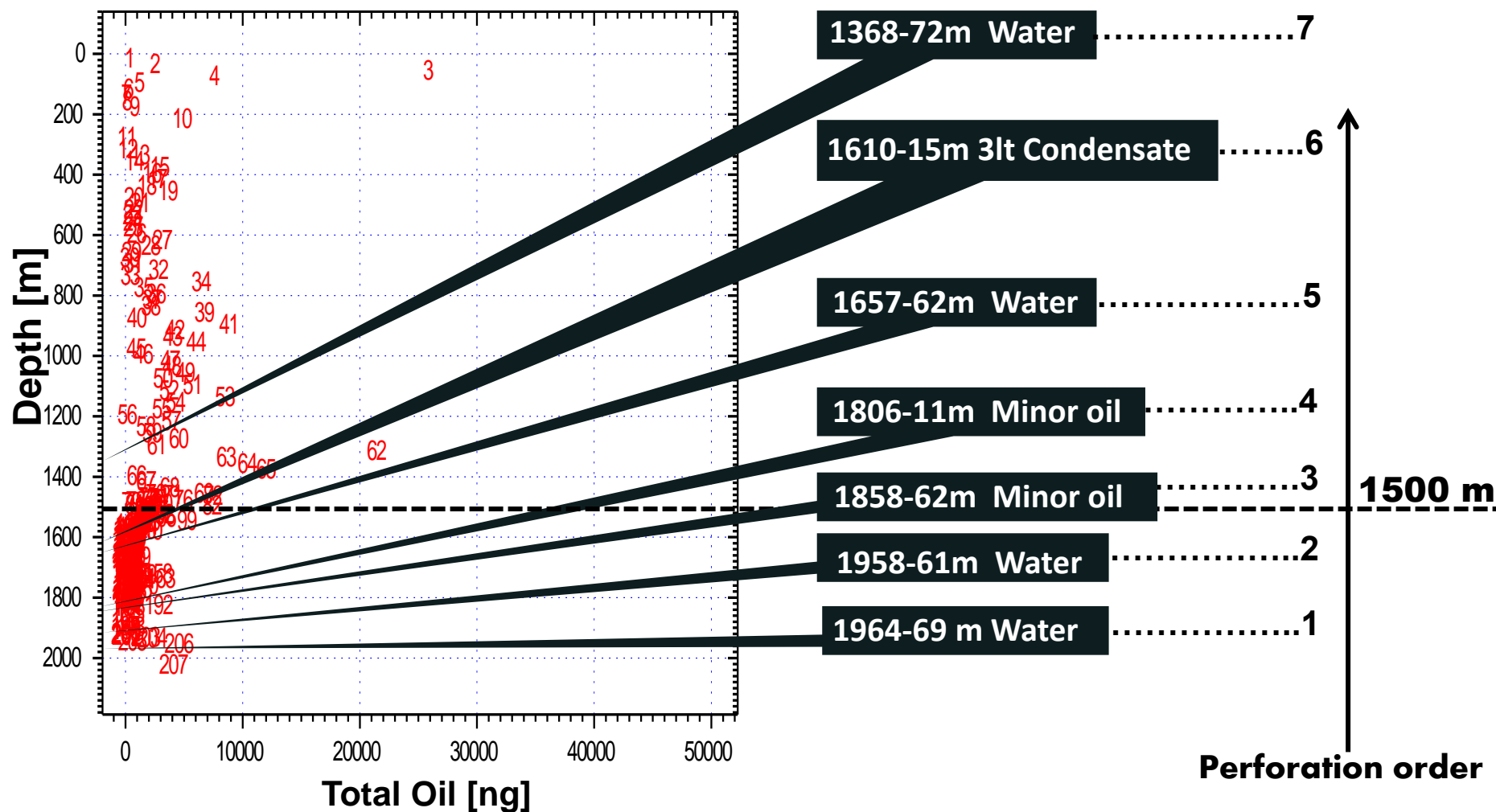
# Sarıkız-3 AGI vs E-Log perforation tests

**AGI**

Suggested no perforation

**E-LOG**

Suggested 7 perforations



# Summary & conclusions

1. Downhole drill-cutting samples collected during drilling operations were treated passively with AGI module in a glass jar.
2. Analysis of AGI modules revealed that they are capable of adsorbing oil and gas-like VOC and SVOCs.
3. The following information can be successfully extracted from drill cuttings by using AGI modules :
  - Oil rich layers [ORLs] or test intervals
  - Ranking of test intervals
  - Compartments and fluid typing and
  - Seal capacity
4. Integration of AGI and E-Log data will propound vital and robust information before well tests.

Thank you for your patience.

If you have any question

I will do my best to answer them.



*Website.* <http://www.agisurveys.net>