

Tight Gas Study Proposal

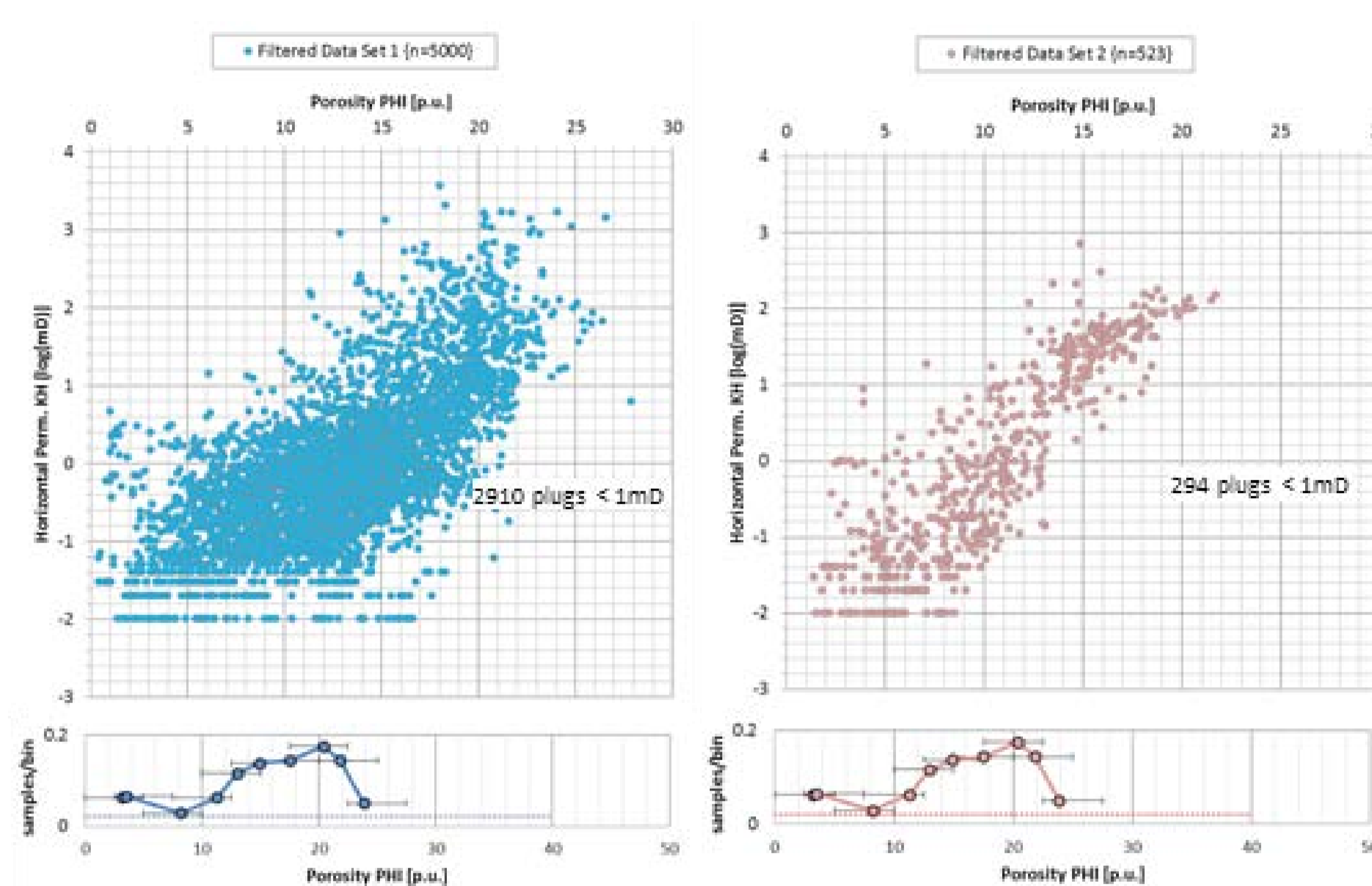
Study Proposal

Many tight undeveloped gas discoveries are found in The Netherlands, although exact numbers are not quantified. Typical reservoirs where poor reservoir conditions can occur are the Rotliegend and Bunter Formations. However, tight gas is also reported in Westphalian, Zechstein carbonates, Triassic, Scruff, Vlieland and Chalk reservoirs.

The estimated tight gas GIIP varies between 100 to 200 bcm (van Hulst, 2006), and Schulte (2012) talks about 50 tight stranded fields. Wintershall acreage alone contains around 30 bcm undeveloped tight gas (Winz, 2006).

The Netherlands has a favorable policy to develop small gas fields, unfortunately an additional incentive to develop tight gas fields still has to come. In 2006 TNO organised a tight gas workshop, since then no orchestrated action has been initiated.

The proposed PanTerra study will give a reservoir description and diagenesis history of the tight offshore gas fields and discoveries, an overview of the well test results and reservoir properties,



Study Plan

1. Form a study promoter group
2. Find support and data use approval with data owners
3. Categorize and map all tight gas discoveries
4. Rock Typing: Prepare a workflow to describe and characterize tight gas sands by systematically integrating core-based macroscopic geologic elements, facies, mineral and clay content, microscopic observations and pore-scale prop-

erties like porosities, permeabilities, capillary pressure and other data such as electrical properties a,m,n.

5. Define burial history for available reservoir data, from literature, wells and seismic

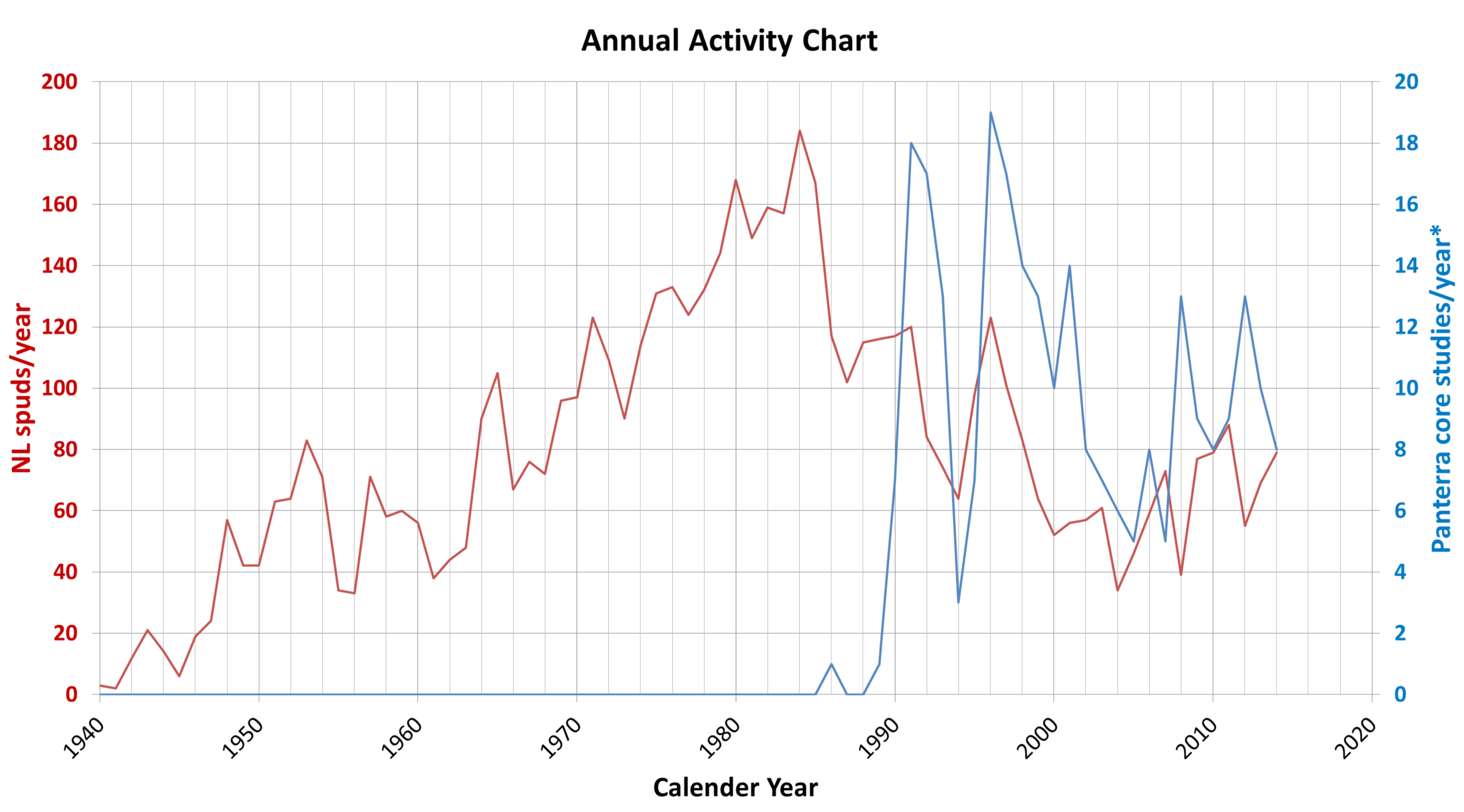
6. Carry out a consistent petrophysical log evaluation

7. All data will be integrated per reservoir (e.g. Rotliegend, Main Buntsandstein), and classes of tight rock will be identified

8. A hydraulic rock-typing approach will be applied to define net pay of tight gas sands using calculated pore throat radius and relative permeability measurements: What is "mobile gas"?

9. Available well test, stimulation and production data will be collected and evaluated to compare the applied techniques and results and correlate them with the rock types defined above.

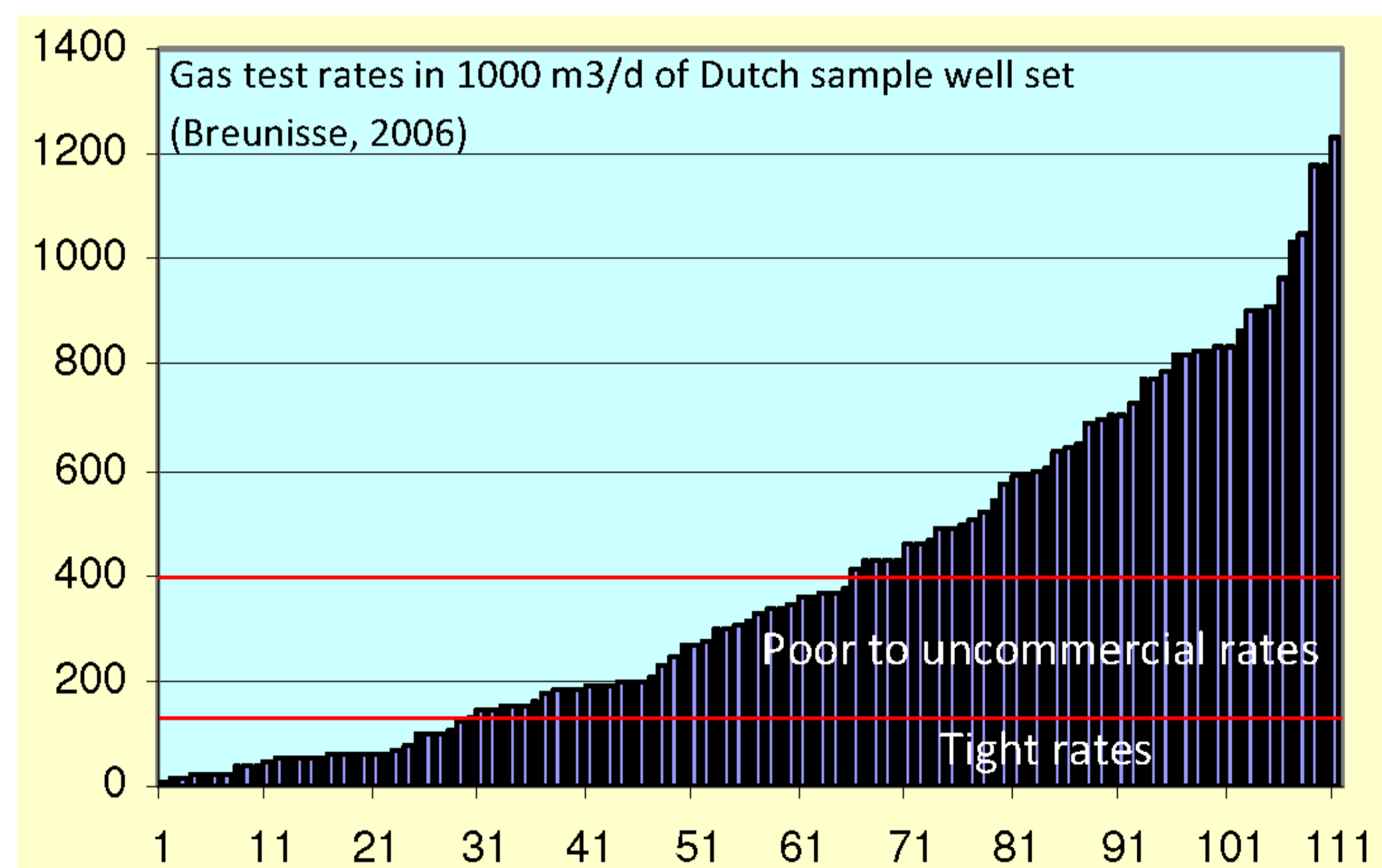
10. Recommendations for a better understanding of common factors for tight gas reservoir origin, can sweet-spots be identified, which stimulation techniques work best, and what are the most reliable methods to calculate production profiles and recovery.



and inventorise the techniques applied to develop tight gas fields. The study will result in different tight gas reservoirs groups, describe the similarities and differences, review the appraisal and development successes, and come with a best practice document for stimulation, data gathering and development of each of these groups.

Why PanTerra

PanTerra is in a unique position to study the characteristics of tight gas fields because of its database and experience with core studies, its geological knowledge of the Netherlands and its experienced G&G and reservoir engineering department. More than 250 Dutch core studies have been exercised by PanTerra (see graph).



A recent PanTerra study (Missed Pay) shows that in the Dutch Southern North Sea 17 out of 56 analysed wells have hydrocarbons in tight reservoir rocks. This number does not take into account wells in licensed areas. A Por/Perm plot of the Rotliegend and Volpriehausen core data indicates that respectively 58% and 56% of the plugs is in the tight gas range.

Budget

PanTerra seeks support with the Dutch O&G industry to start this none-proprietary study with a duration of about one year with a total initial cost estimate of 360,000 Euro.

Challenge

The main challenge is to find permission from data owners to use proprietary core evaluation data. Essential for a successful project will also be to obtain proprietary stimulation and production data from current producing tight gas fields.

