# Overpressure Estimation

What do we mean under the expression “overpressure” ?

Sediments, rocks are built up of small particles. These particles are stacked together, stacked on each other, forming a rock skeleton. They used to call this skeleton also as the “rock matrix”.

In between the small rock particles there are holes, what we call “pores”. These pores are filled by some kind of fluids.

In normal circumstances the particles of the rock matrix hold themselves and the fluid can flow freely in the pores. The pressure in the fluid at a specific depth comes from the weight of the fluid column above the given depth. This is the so called “hydrostatic” pressure what depends only on the density of the fluid and the height of the fluid column. The “hydrostatic pressure gradient” is nothing else than the density of the fluid itself.

There are cases, when the fluid can not flow freely, because it is trapped into some kind of sealed formation. This case the fluid has to hold additionally a part of the weight of the rock column too, since it is pressing the sealed formation, where the fluid is trapped. The pressure in the fluid will be higher than the “hydrostatic” pressure.

This is what we call “overpressure”.

In these over pressured zones the fluid (since it can not escape, and also, it is nearly incompressible) does not let the pores to compact. The result is an abnormal high porosity.

The high porosity means relatively slow wave propagation velocity and this is the parameter, what we can monitor by using the seismic wave propagation velocities.

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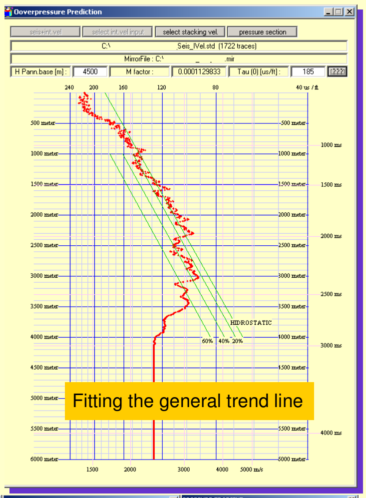
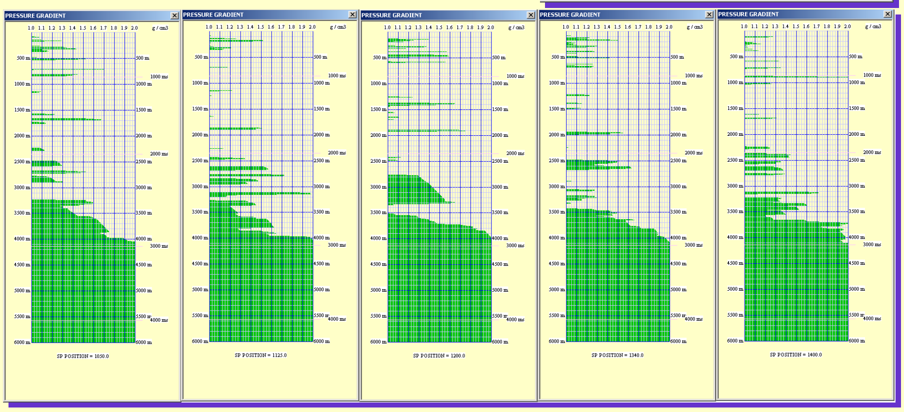
## Overpressure estimation using seismic interval velocities

We started to study the overpressure situation in the Pannonian Basin at the end of the seventies. At that time we assembled the data of nearly 300 wells, where the mud weight was properly recorded. Also, we collected the available sonic logs, or we computed sonic values from resistivity logs. We developed a formula to obtain the slope of a trend line, representing the relationship between depth and wave propagation velocities in the normally compacted layers. Also, we estimated the trend lines of the different over pressured situations.

This trend-line formula was especially created for the Pannonian Basin. Later on this formula was revised and extended for general use; based on better sonic logs and new techniques.



Changes in pressure gradient along a seismic line. The first increase, which is coming in patches only arrives at the deeper parts of the Lower Pannonian. The big jump starts in the Miocene.

## The most critical part of the analysis is to get accurate seismic velocities

To estimate the overpressure, we have to get interval transit time values. Interval transit time is the inverse of the seismic interval velocity.

To get meaningful results, we have to go to the limits of the seismic resolution and compute seismic interval velocities for the possible thinnest layers. This task exceeds the accuracy of the conventional seismic data processing.

Specifically for this task, we developed a fine method of seismic stacking velocity analysis.

The errors in the stacking velocities are less then half percent and this guaranties that in the interval velocities there will be no larger errors than 5-10%. This accuracy is good enough for the overpressure analyses.

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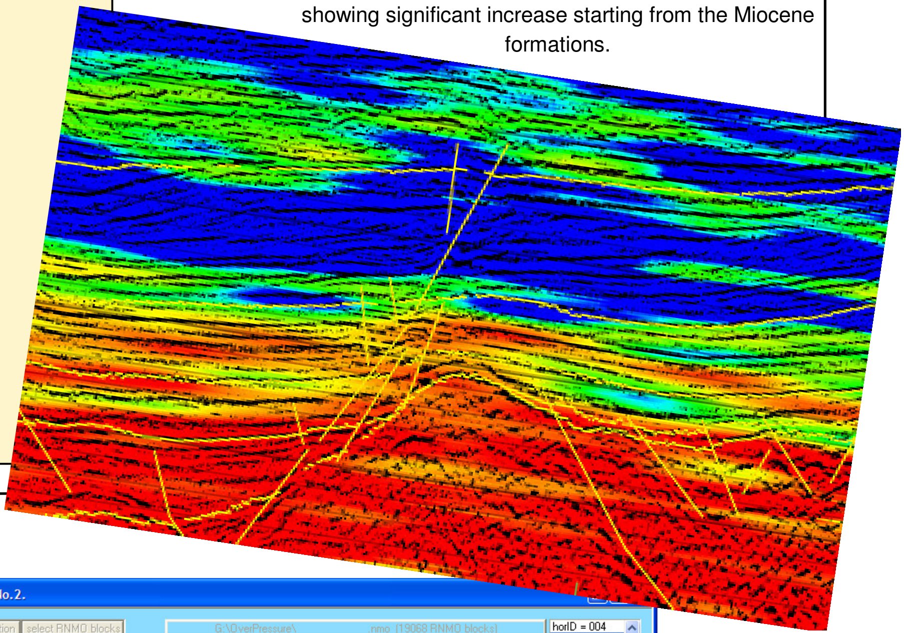
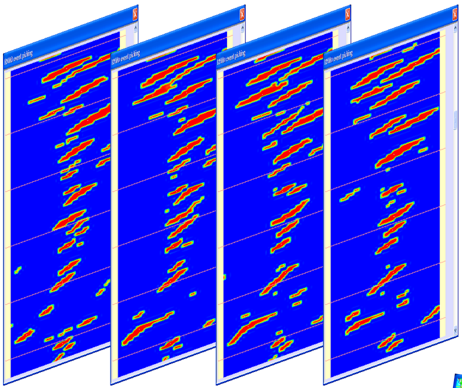
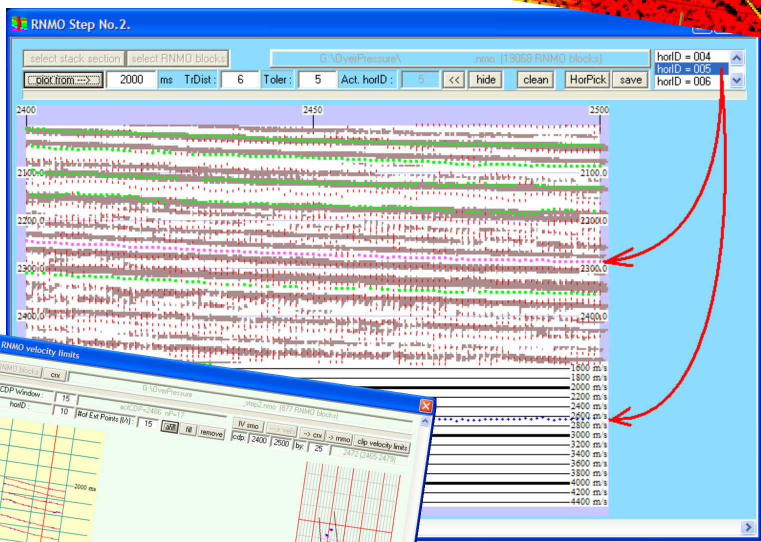
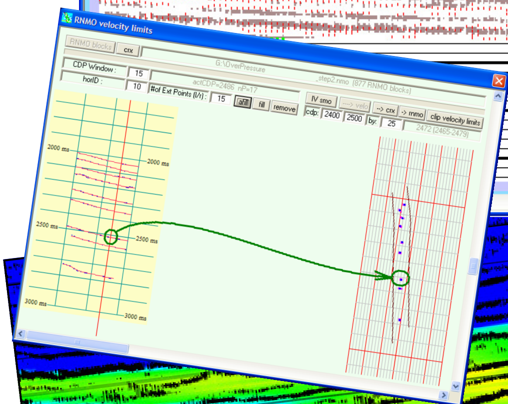
Pressure gradient overlaid on a seismic time section showing significant increase starting from the Miocene formations.





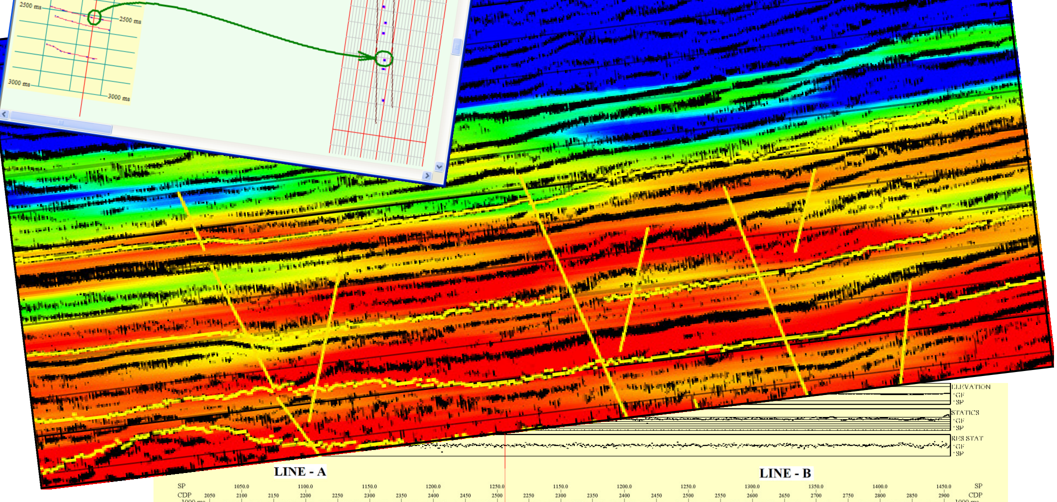


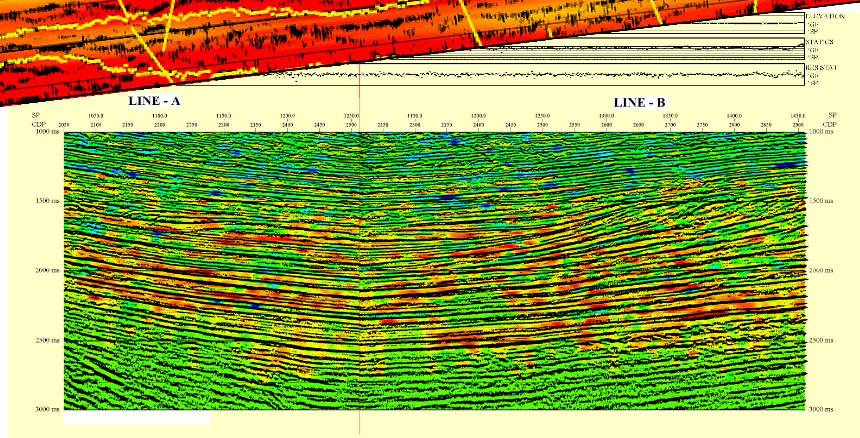




The idea of our velocity analysis module goes back to the old GSI 600 package, published sometimes in the late sixties, early seventies. To any feature, which resembles to a hyperbolic shape in the CDP domain, we attach an “event”.

Every event has an amplitude, a two way arrival time and a seismic stacking velocity value. It also has a measure of reliability, obtained from the statistics of the input data.

Sorting, filtering these events in time and space, we select the points, which are most likely related to real seismic primary reflections. We keep only the events, when it is possible to compute meaningful seismic interval velocities in between two point pairs.






The picture to the right shows the interval velocities of two intersecting seismic lines.

These two intersecting lines were processed independently. We can estimate the accuracy of the interval velocities by comparing them at the intersecting point. Even the small details fit properly.