



Effects of Stratigraphy on Geothermal Reservoir Performance

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Factors

Many factors influence geothermal reservoir performance:

- É Reservoir type
- É Fluid properties
- É Rock properties
- É Temperature
- É Structural geology
- É Stratigraphy
- É Others

This paper focuses on stratigraphy, specifically cap rock.



An Idealized Geothermal System

For the investigations described in this paper, a model comprising a 4-layer stratigraphic column was used:

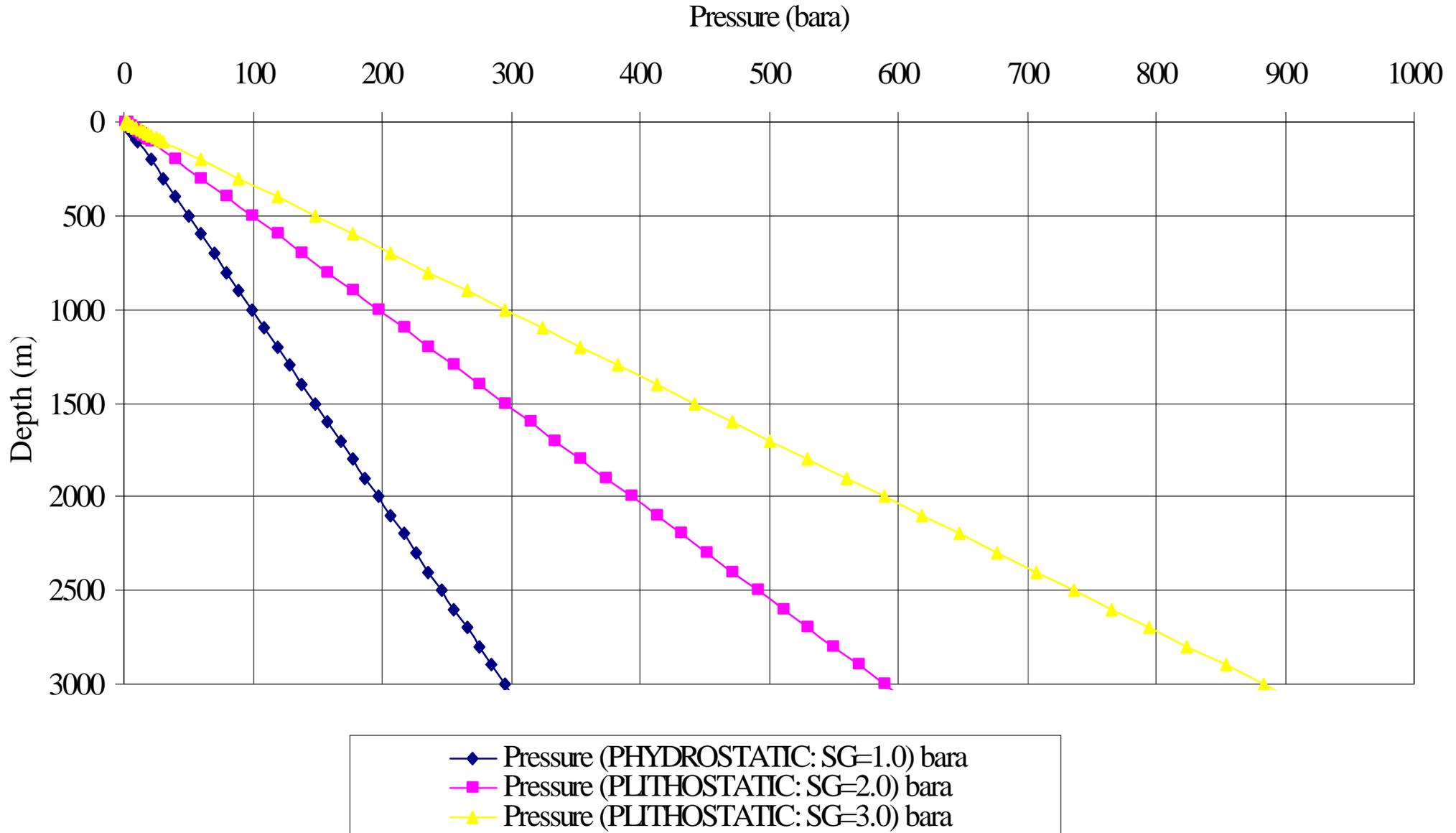
É Atmosphere (cool, partially-saturated, heat sink)

É Cap rock (warm, porous, saturated, insulator)

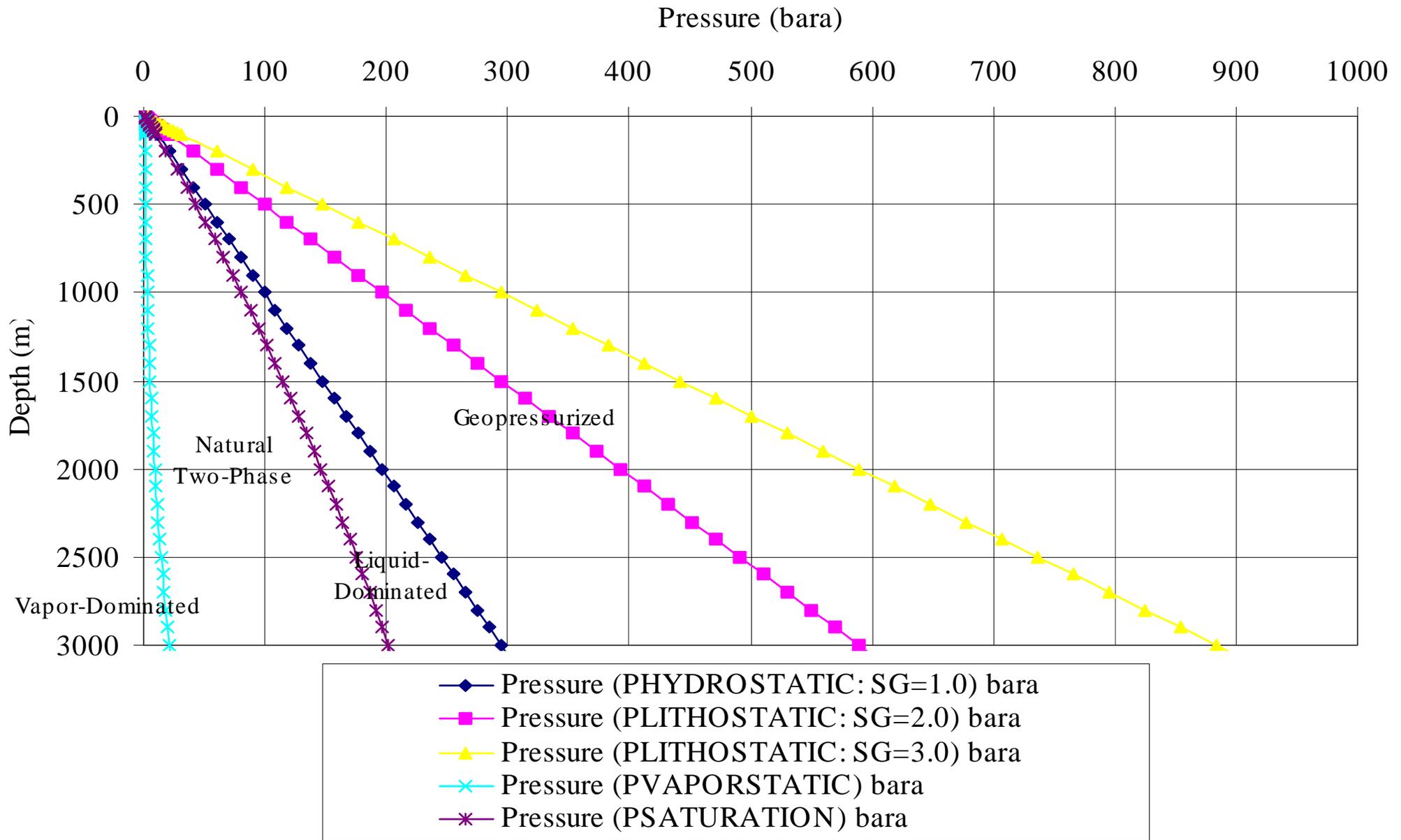
É Reservoir rock (hot, porous, saturated fluid source)

É Basement rock (hot, porous, saturated heat source)

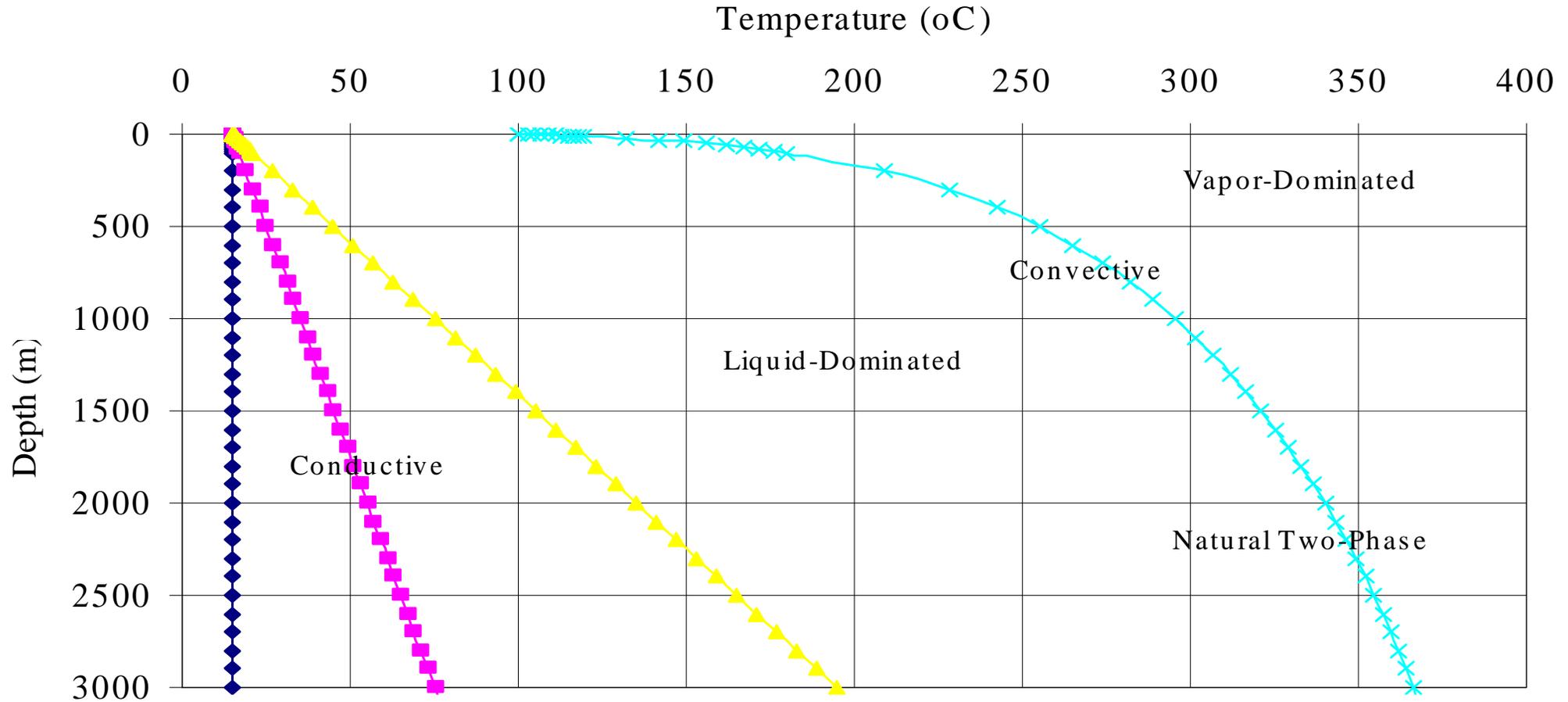
Pressure Gradients of Cold Water Systems



Pressure Gradients of Geothermal Systems

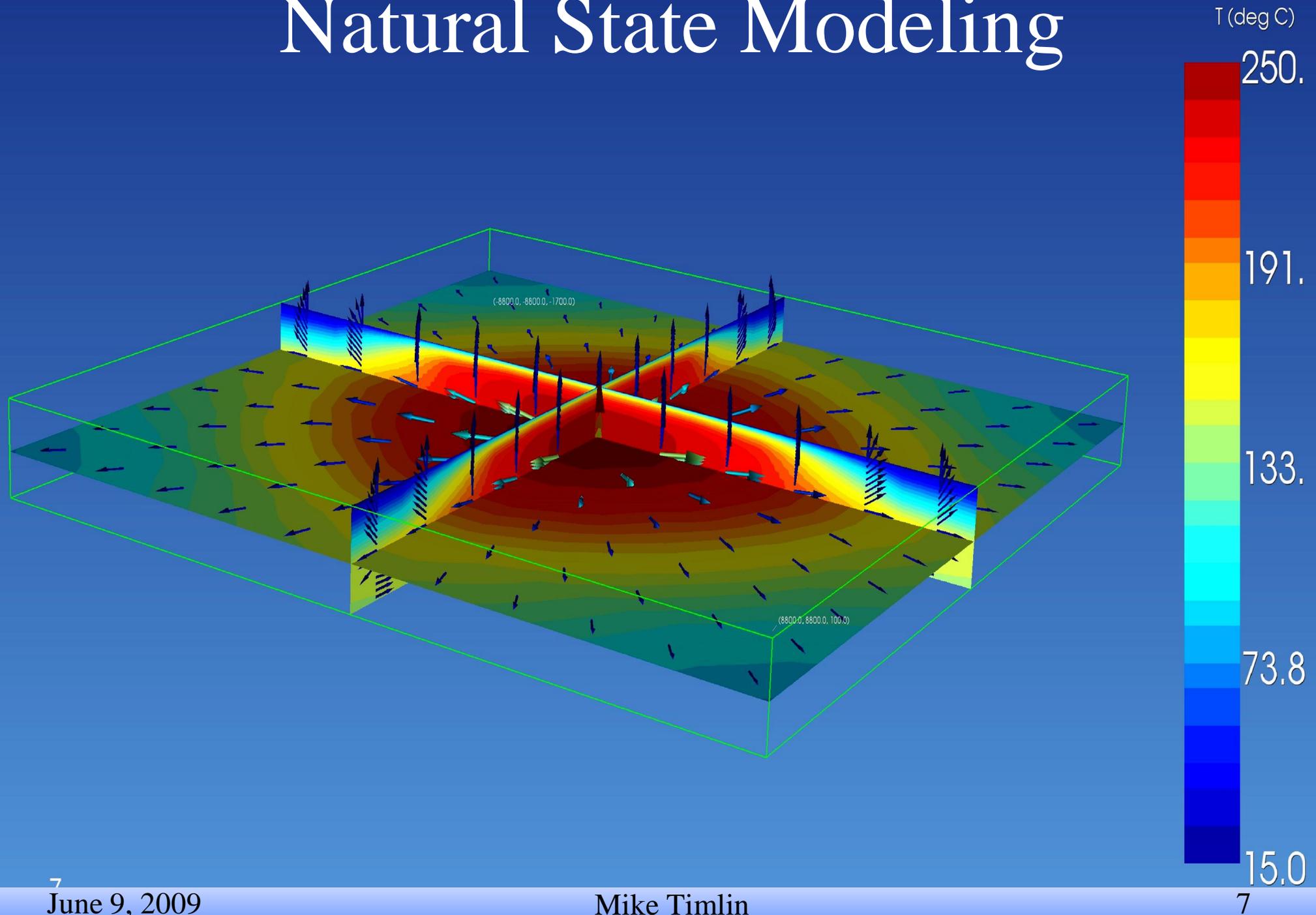


Temperature Gradients of Geothermal Systems

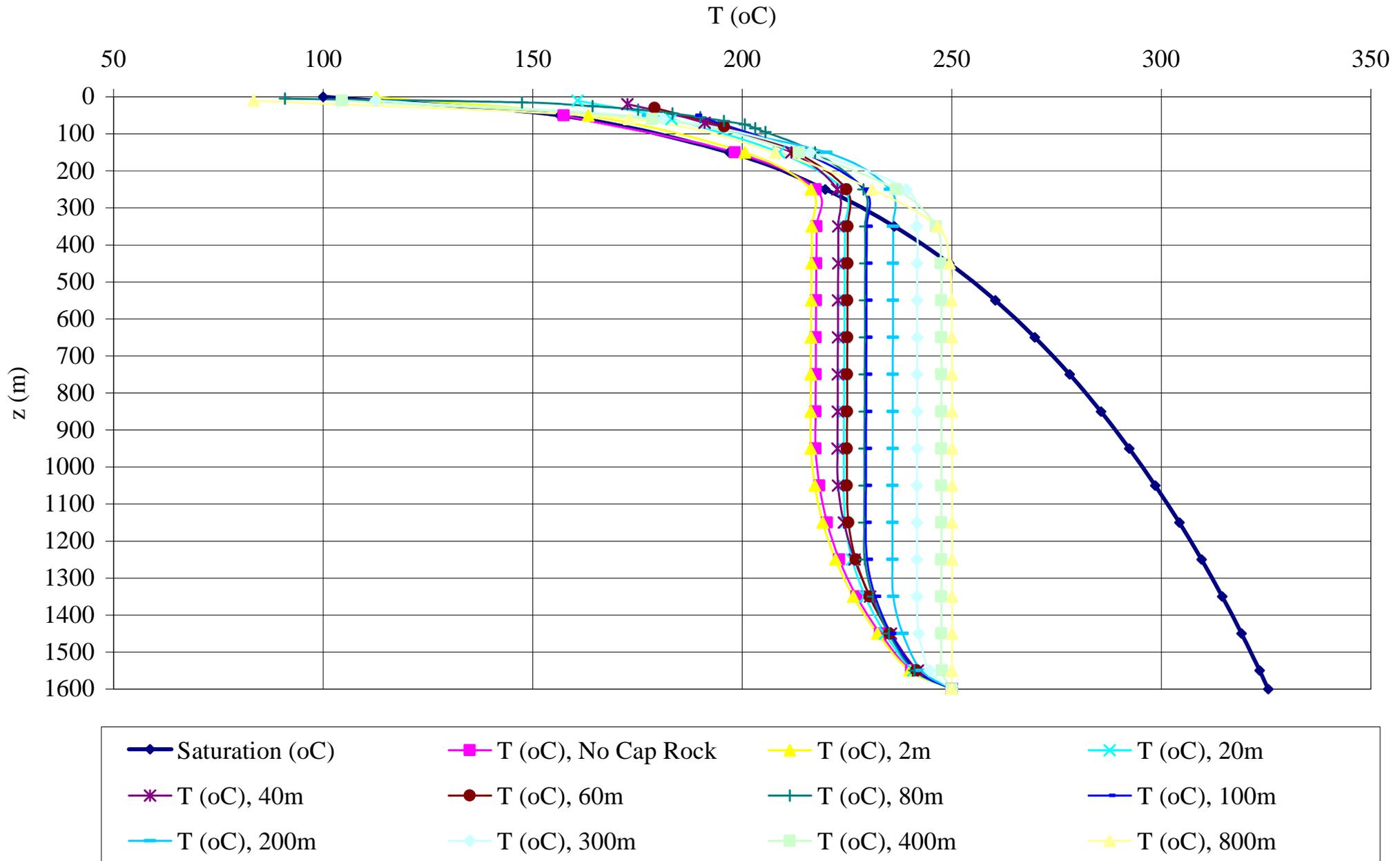


- ◆ Temperature (THYDROSTATIC) oC
- Temperature (TAVERAGE CONDUCTIVE) oC
- ▲ Temperature (THIGHLY CONDUCTIVE) oC
- × Temperature (TSATURATION) oC

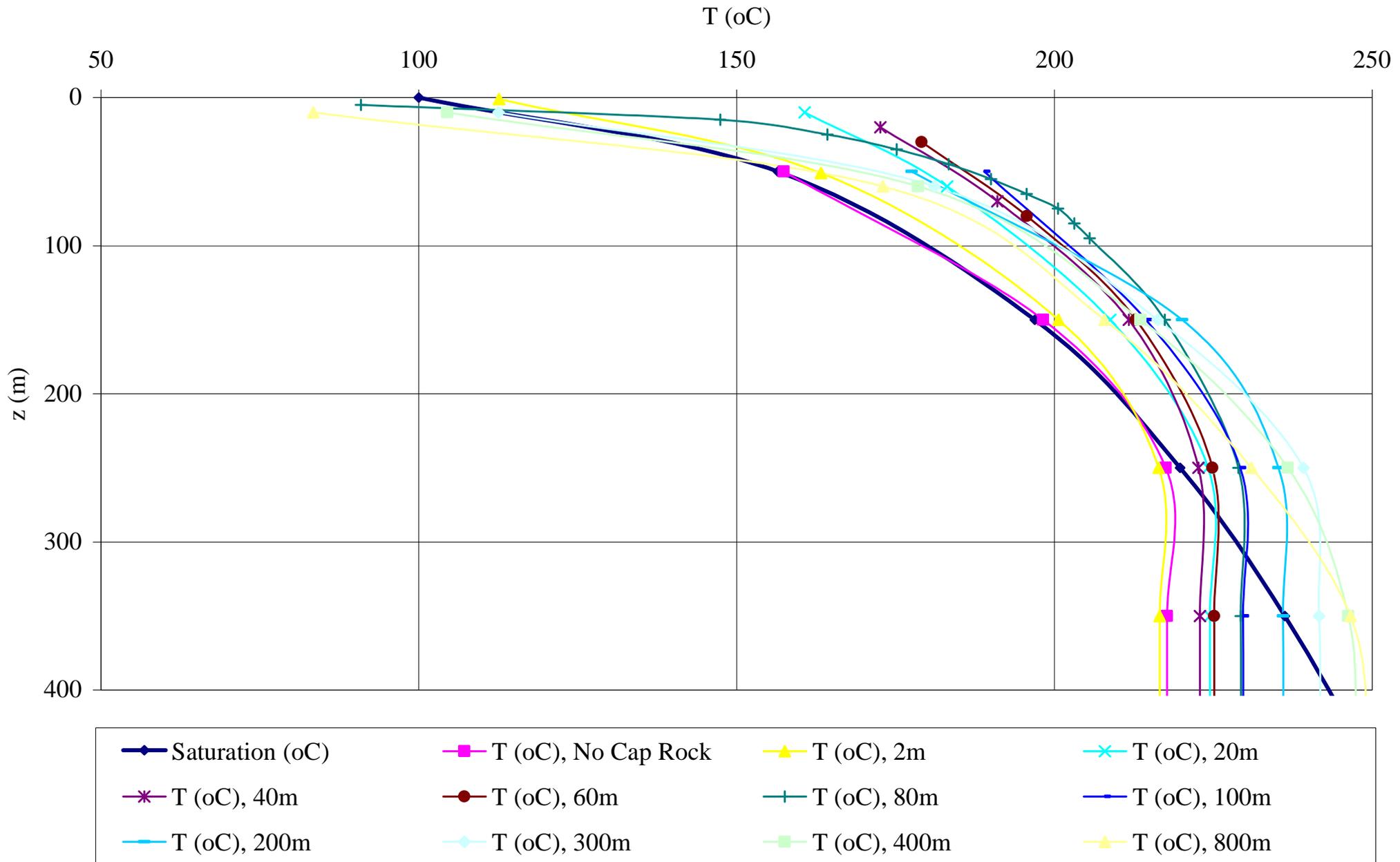
Natural State Modeling



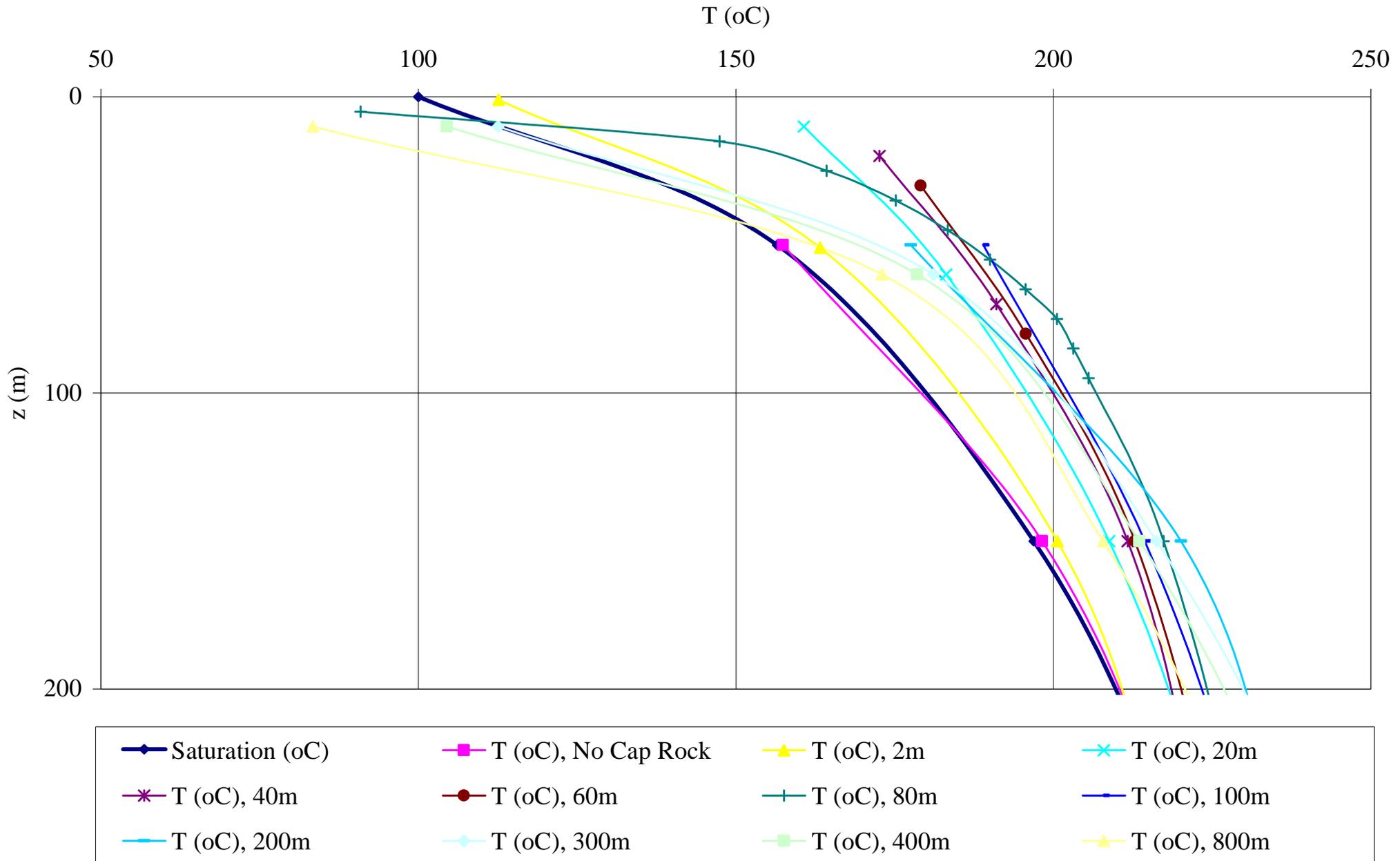
Temperature Profiles vs. Cap Rock Thickness



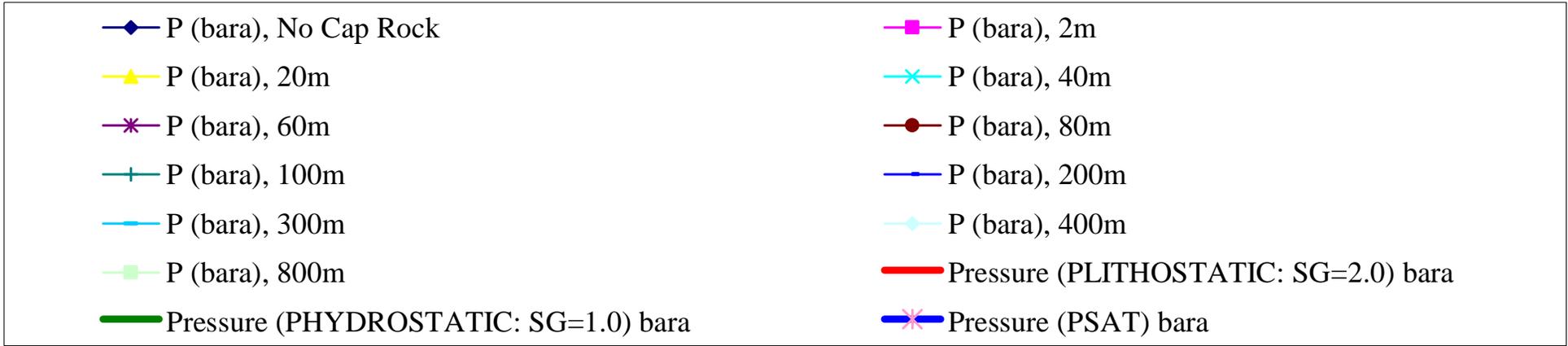
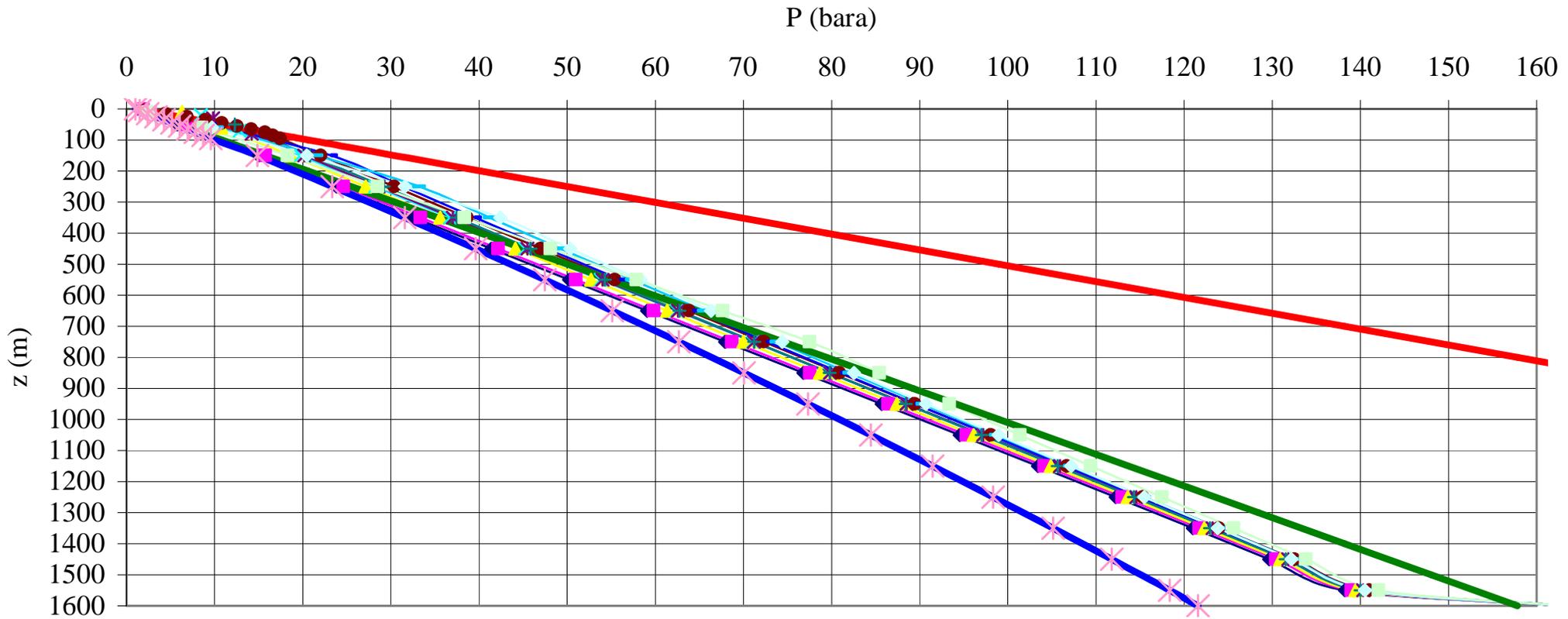
Temperature Profiles vs. Cap Rock Thickness



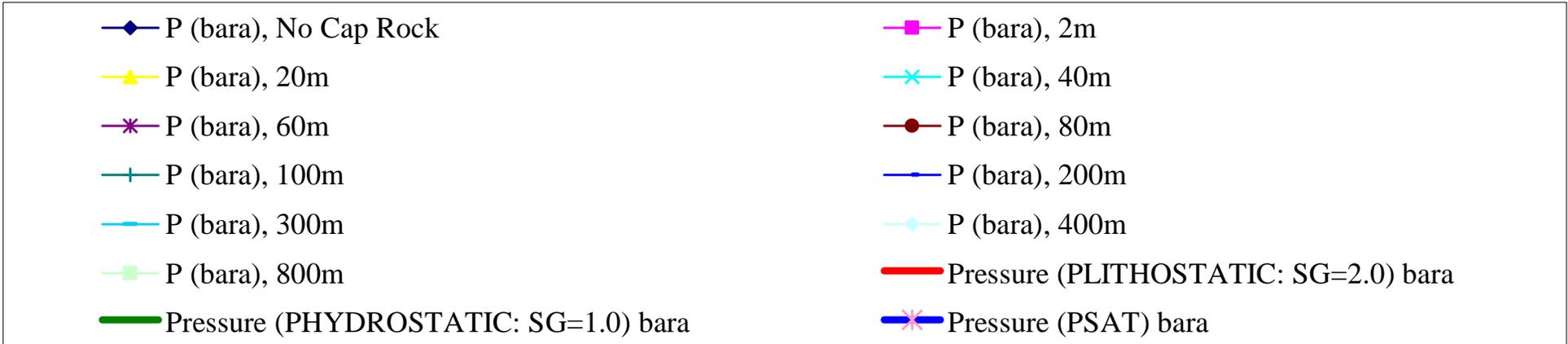
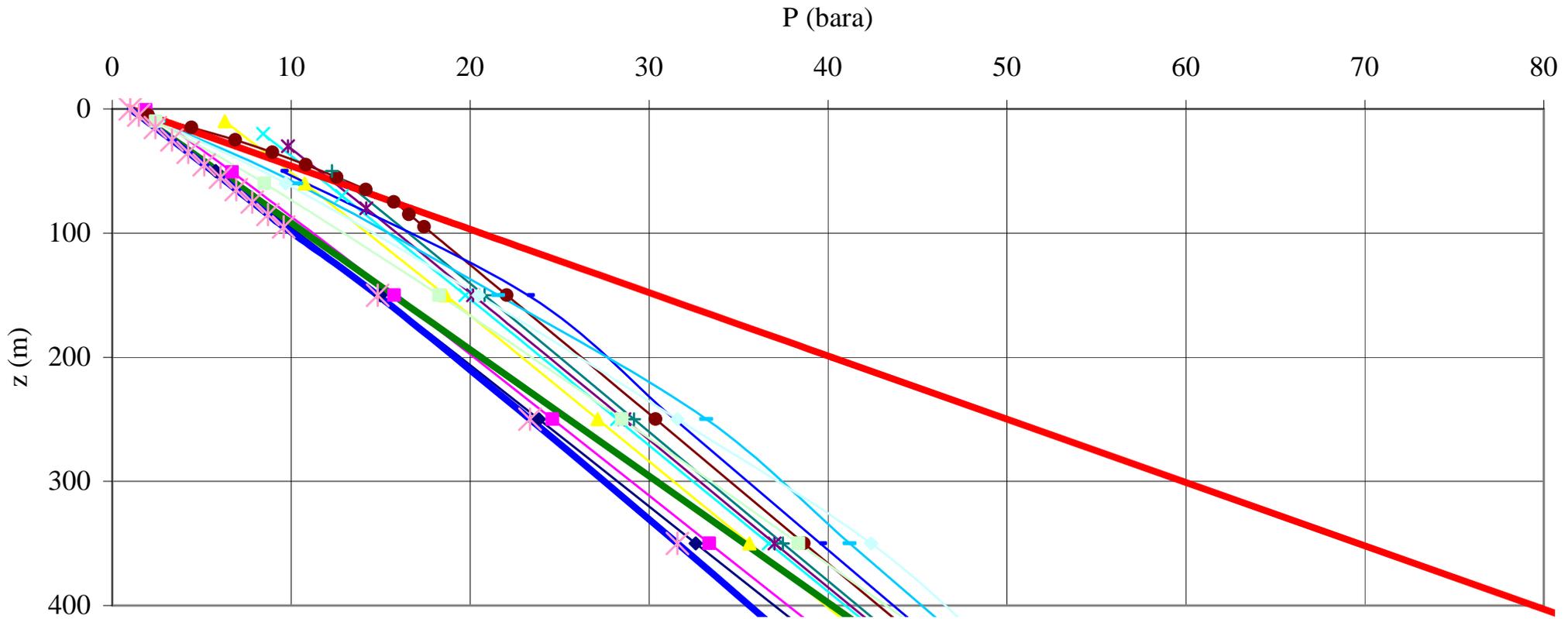
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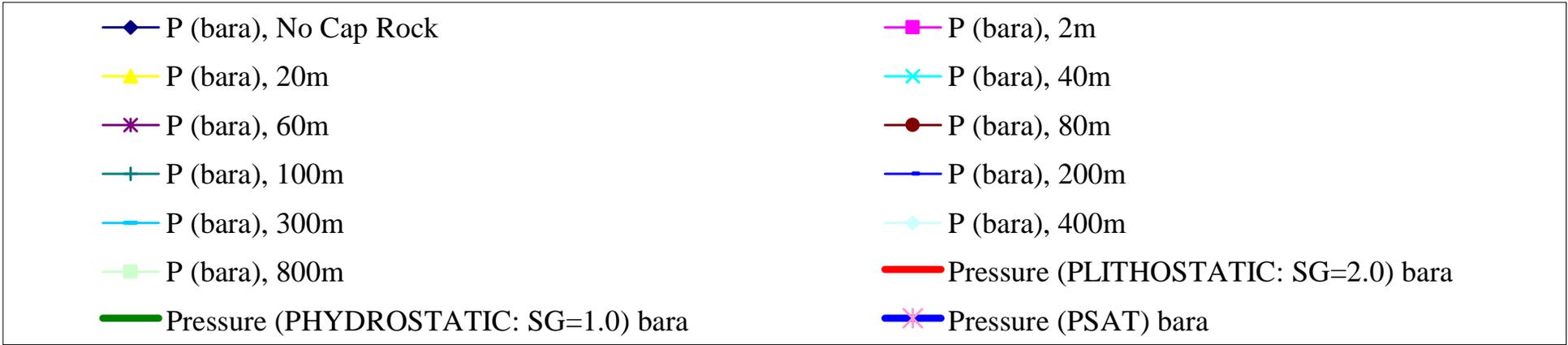
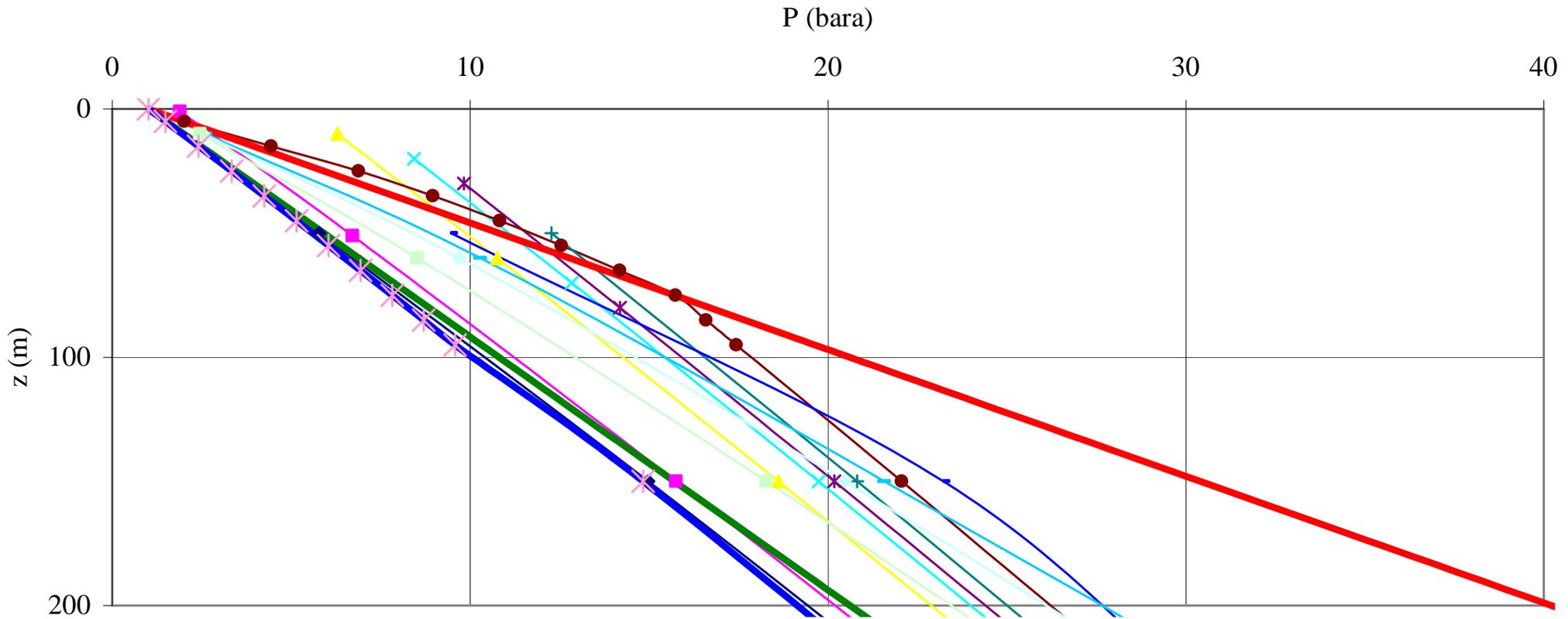
Pressure Profiles vs. Cap Rock Thickness



Pressure Profiles vs. Cap Rock Thickness

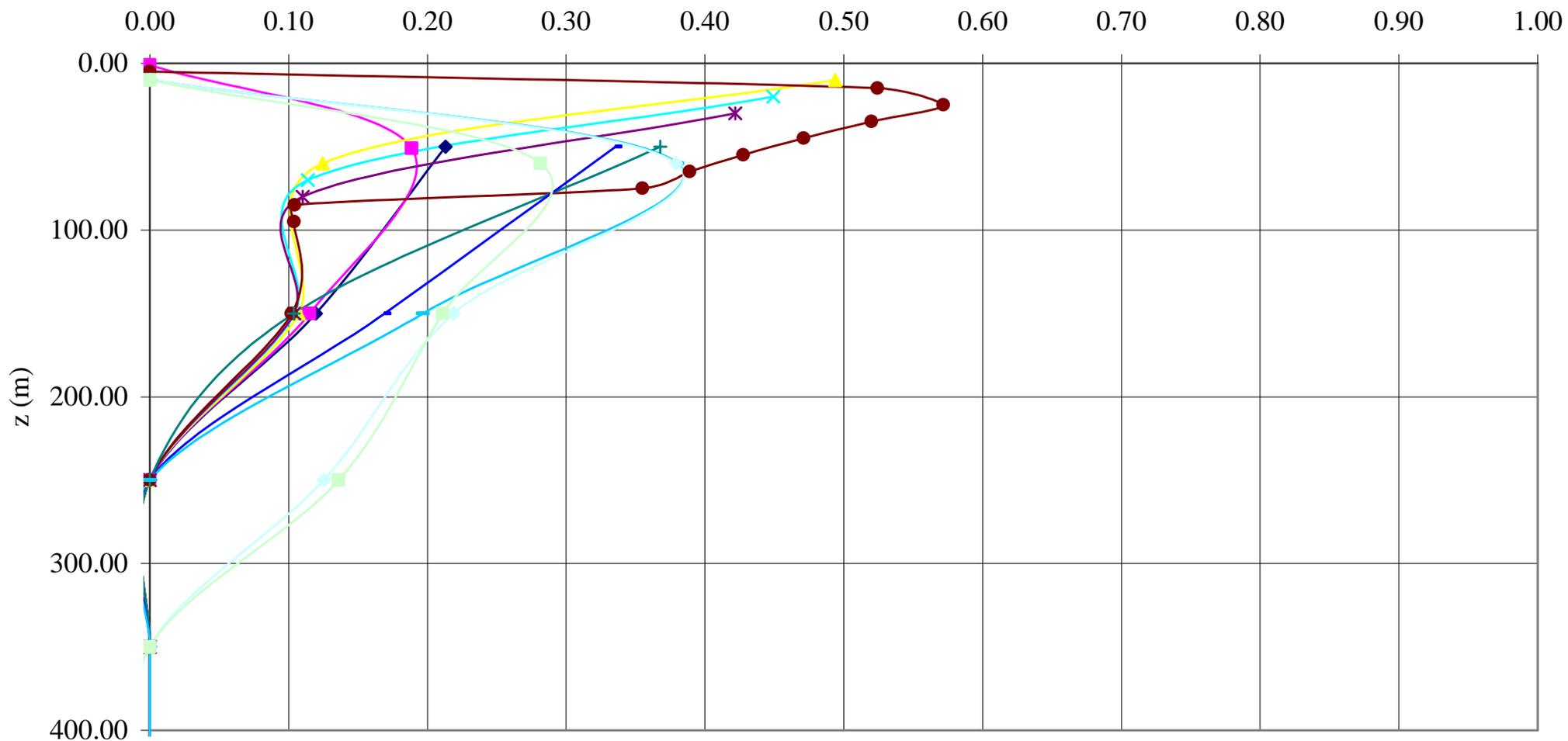


Pressure Profiles vs. Cap Rock Thickness



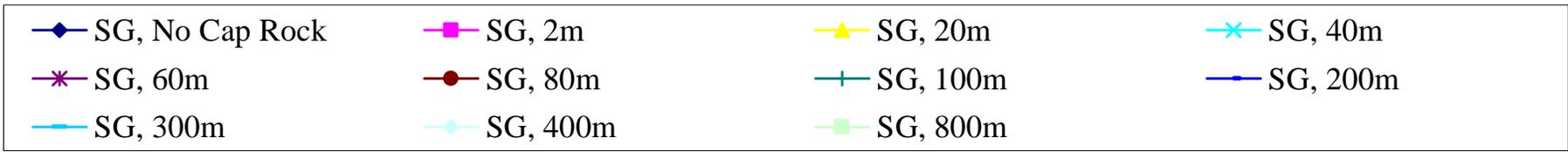
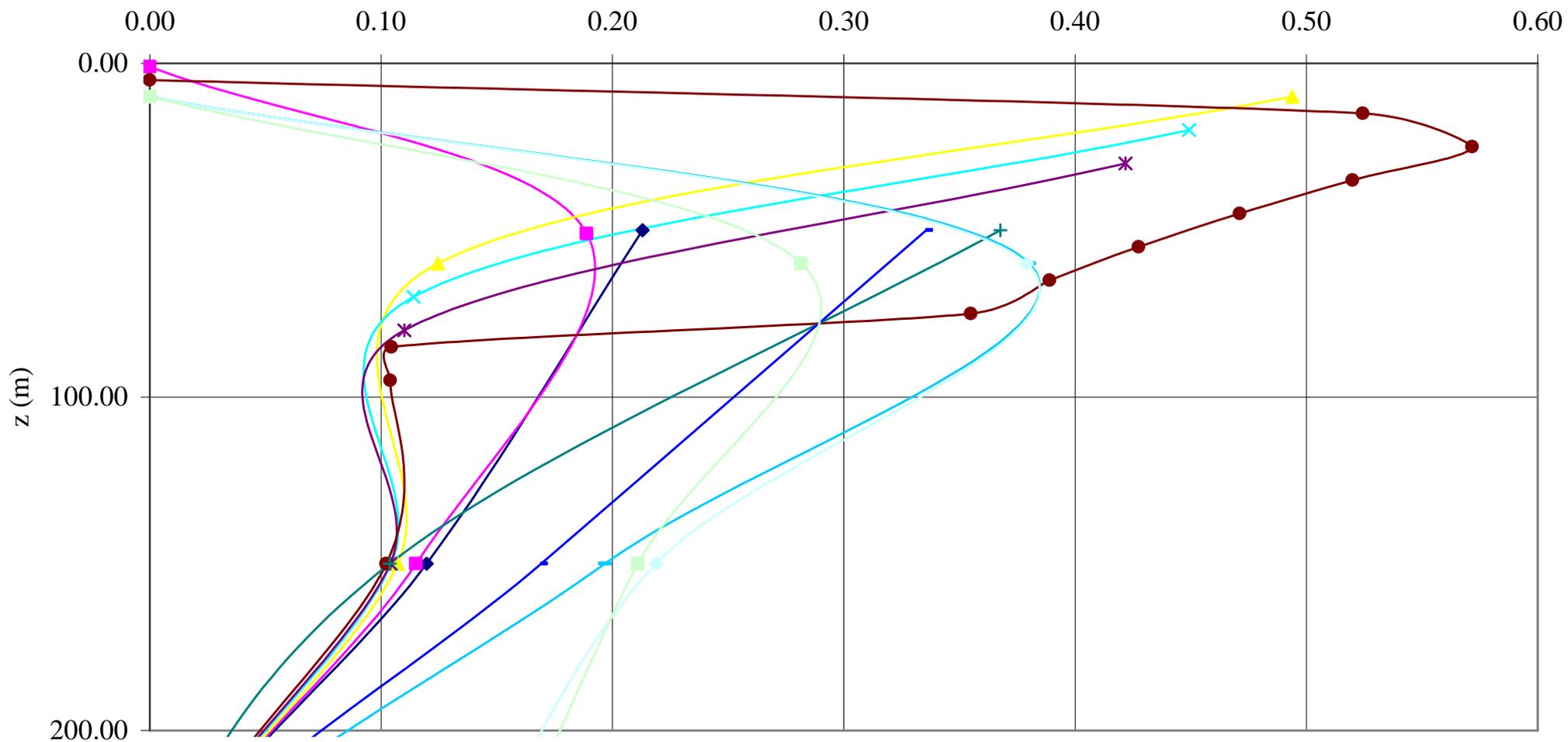
Vapor Saturation Profiles vs. Cap Rock Thickness

Vapor Saturation

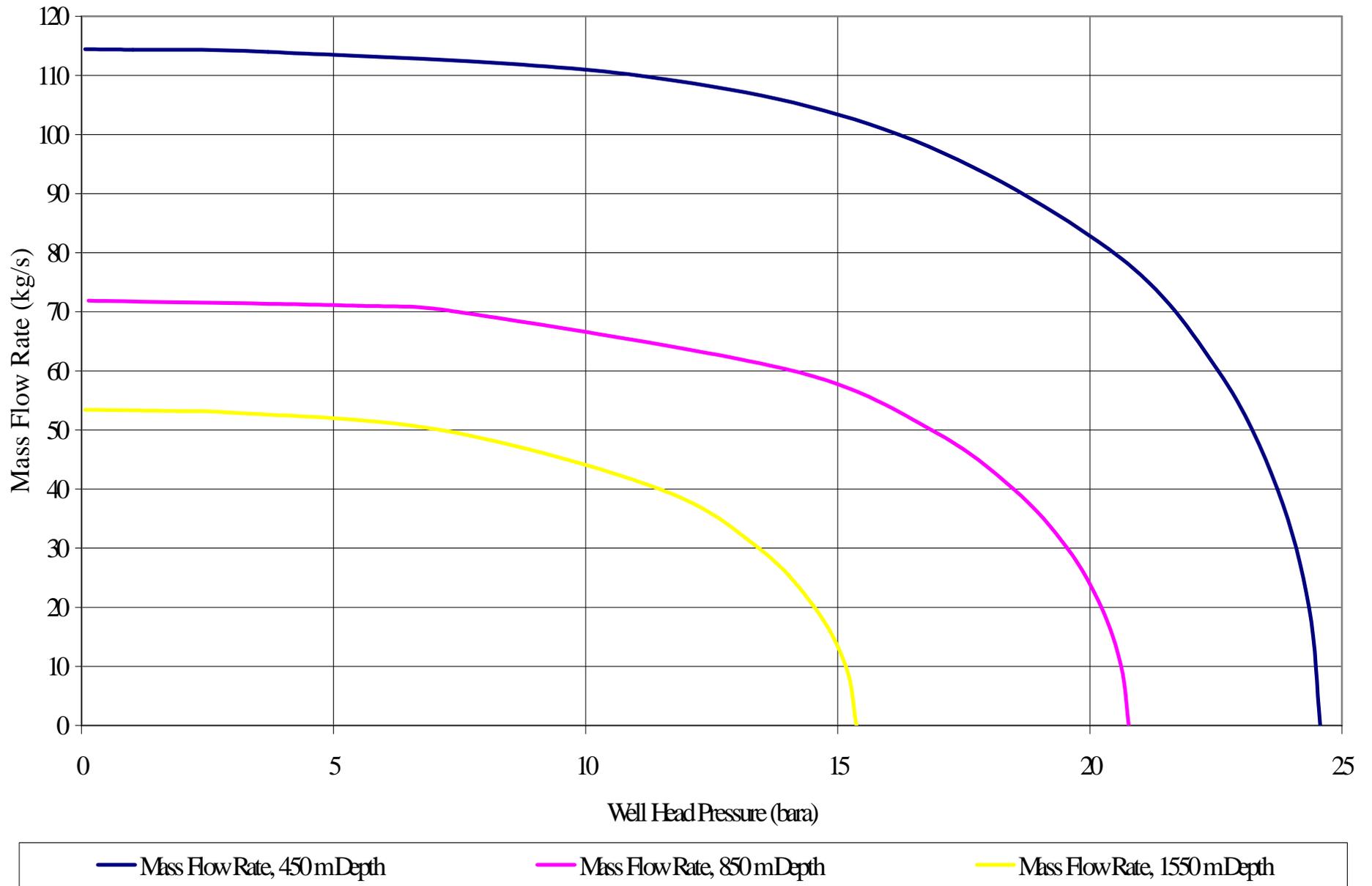


Vapor Saturation Profiles vs. Cap Rock Thickness

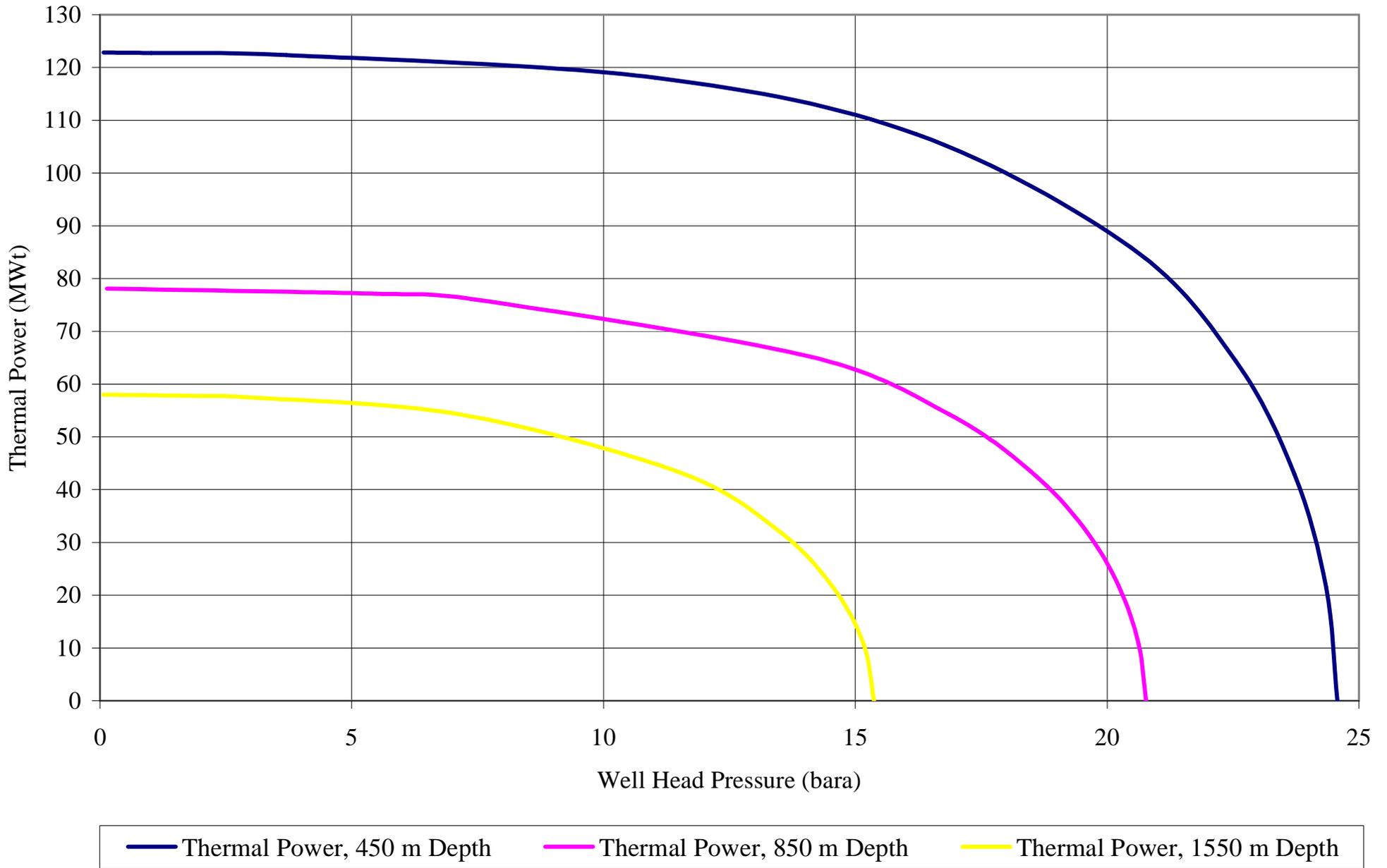
Vapor Saturation



Well Deliverability Curves



Well Power Curves





Conclusions

Cap rock thickness is a key factor in the formation and performance of geothermal reservoirs.

While geothermal reservoirs can form without the presence of a cap rock layer, these will tend to be cool, small, and unstable.

Geothermal reservoirs with thin cap rock layers will tend to be hotter, larger, and less stable than those without any cap rock.

There seems to be a critical thickness above which the reservoir becomes progressively more stable.

With cap rock layers of sufficient thickness and integrity, we will probably see little or no surface temperature elevation and few or no surface expressions; theoretically, this proves the probable existence of many hidden reservoirs.



Acknowledgements

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References

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