Measurements and characterization of hydraulic conductivity of the peridotites of New Caledonia : the case of Massif du Sud

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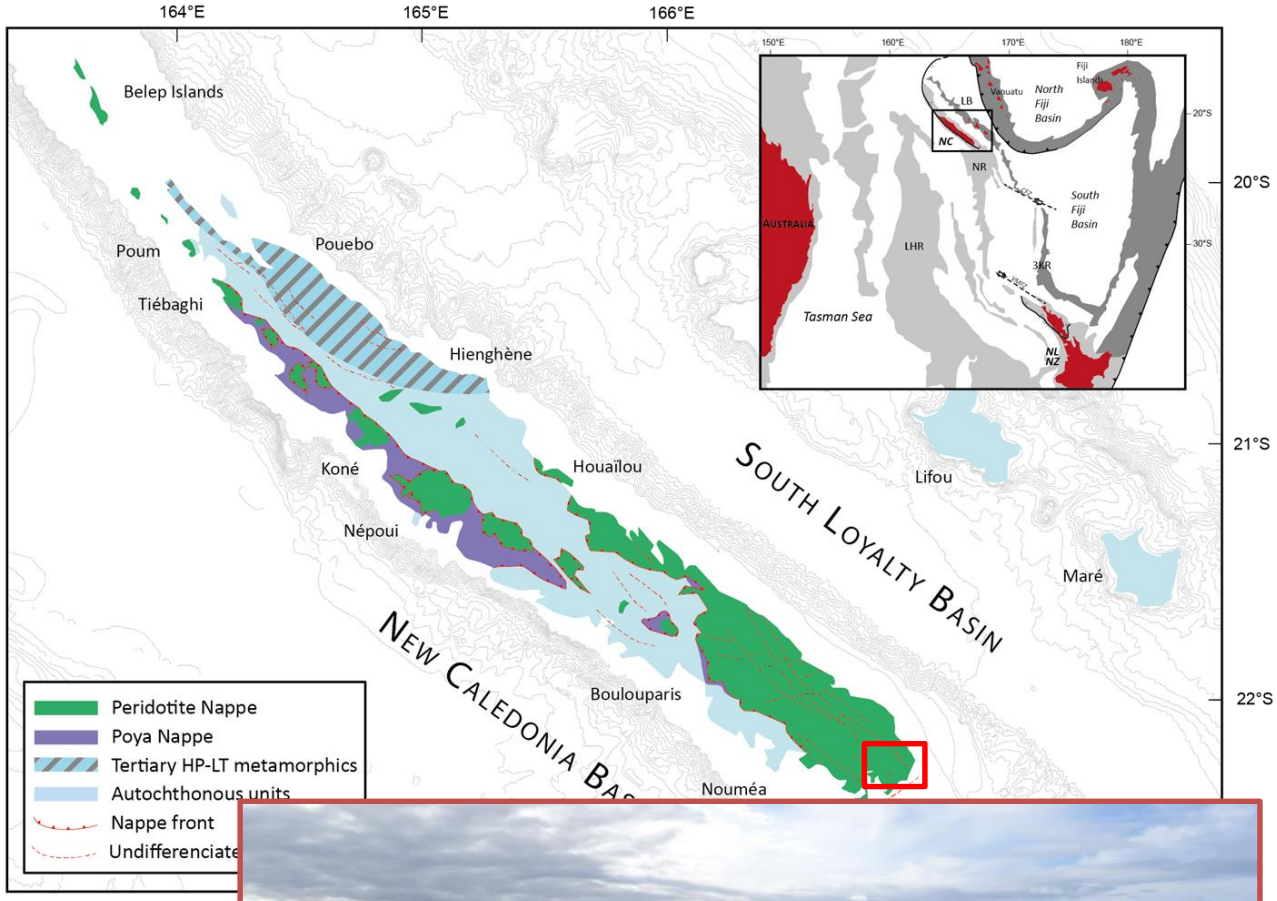
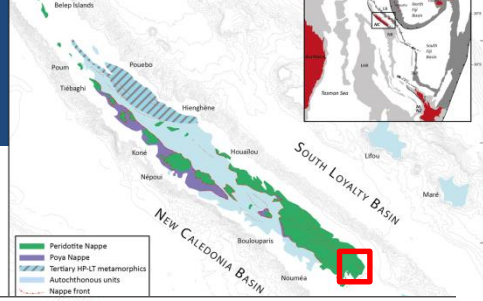
Introduction

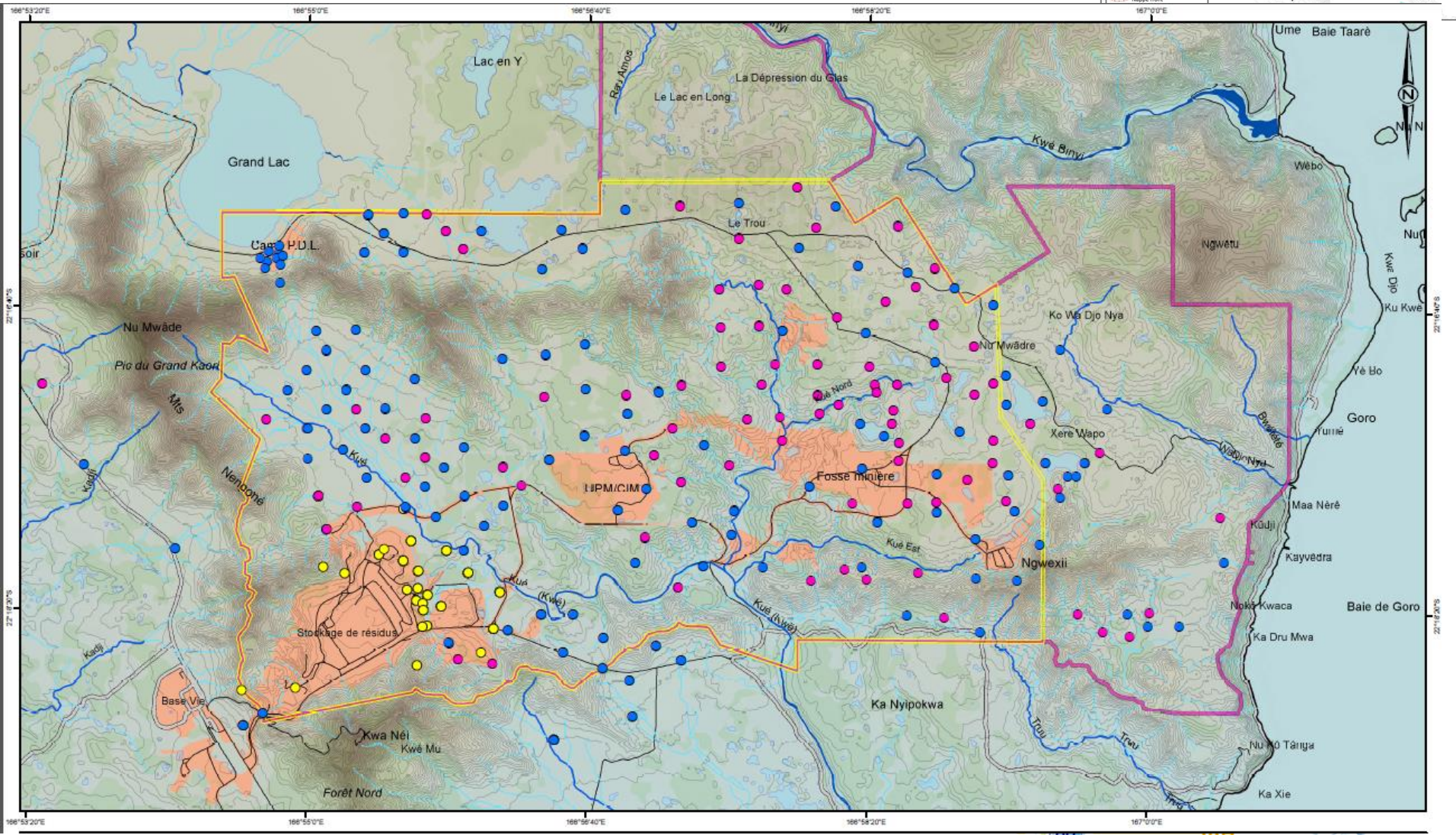
- Peridotites cover 1/3 of Grande Terre (SW Pacific)
- Obduction during Late Eocene (38 Ma) (Cluzel, 2001)
- Weathering since 25 Ma (Sevin et al., 2012)



Massif du Sud : Basins surounded by peridotites ridges

Introduction



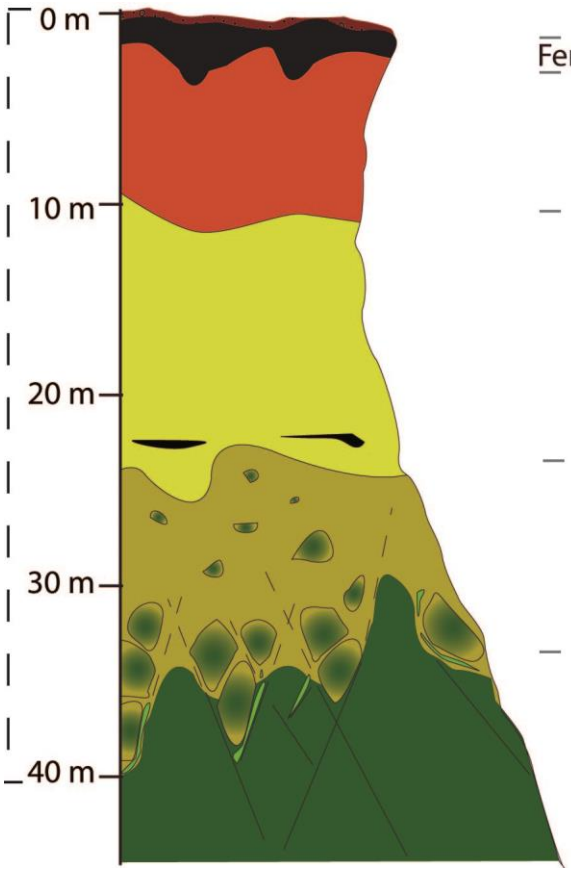


Introduction

- Weathering profile

Lateritic piezometer

Saprolite piezometer



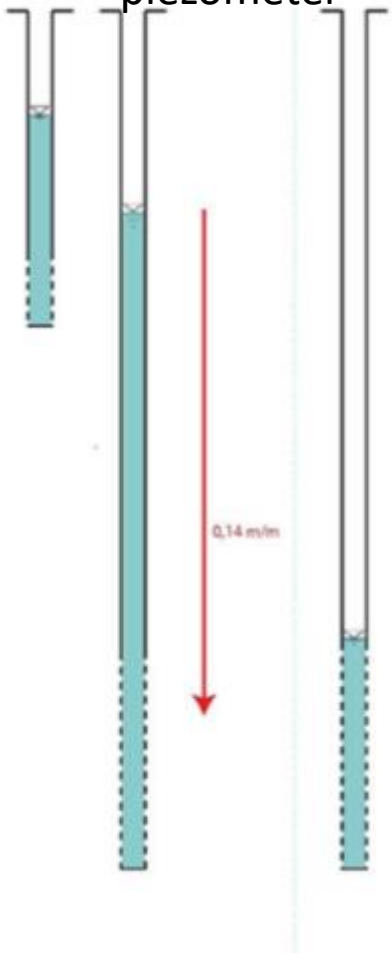
Pisolitic layer
Ferricrete or lateritic duricrust

Laterite

Saprolite
(fine saprolite)

Coarse saprolite

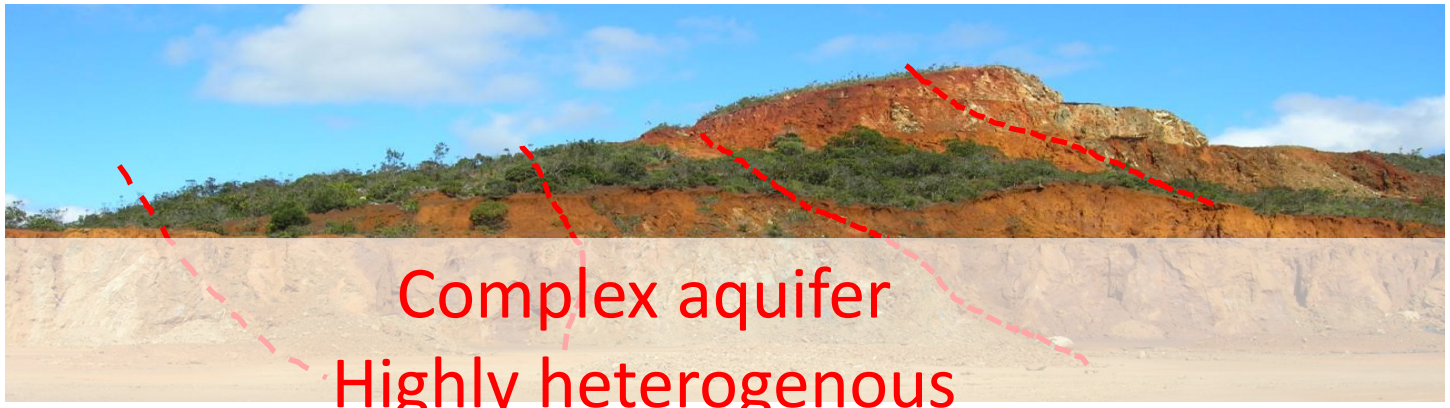
Bedrock
or fresh peridotite



Introduction

- Weathering profile on hard rock aquifer

Tabular but also deepening of the weathering (along fault)



Complex aquifer
Highly heterogenous
=> Importance of the characterization of the hydraulic conductivity

Karst evidences

Lapiaz

Spring

Doline (Jeanpert *et al.*, 2016)

Tracer test : flow transport up to 100 m/h

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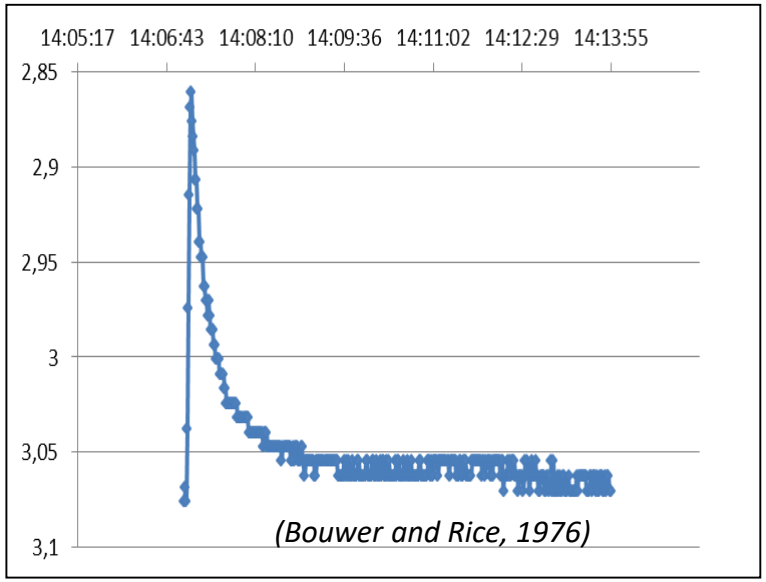
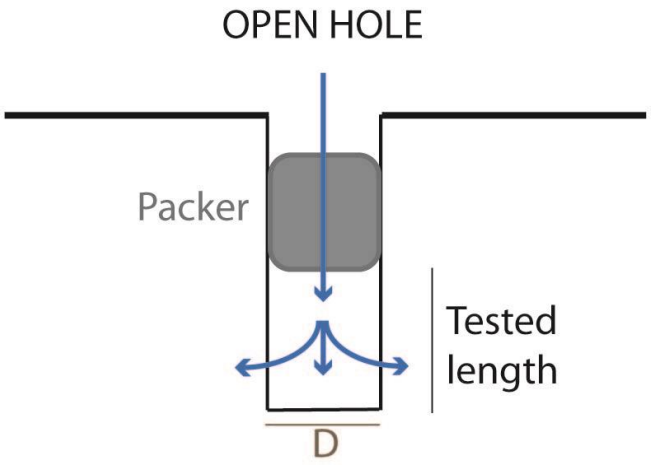
Hydraulic tests

- **Slug test** :
38 boreholes

- **Pumping test** :
10 + 8 boreholes

- **Packer testing** :
42 boreholes (336 tests)

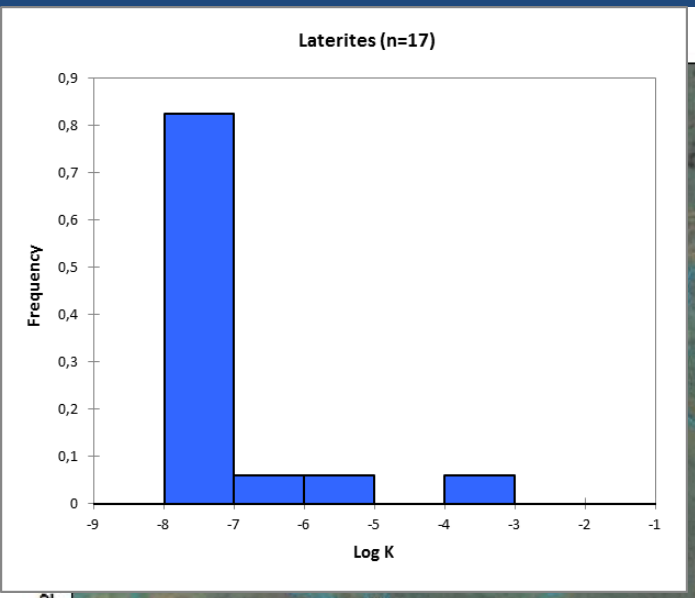




Bibliographic data from Golder Associates and Vale NC

Hydraulic tests

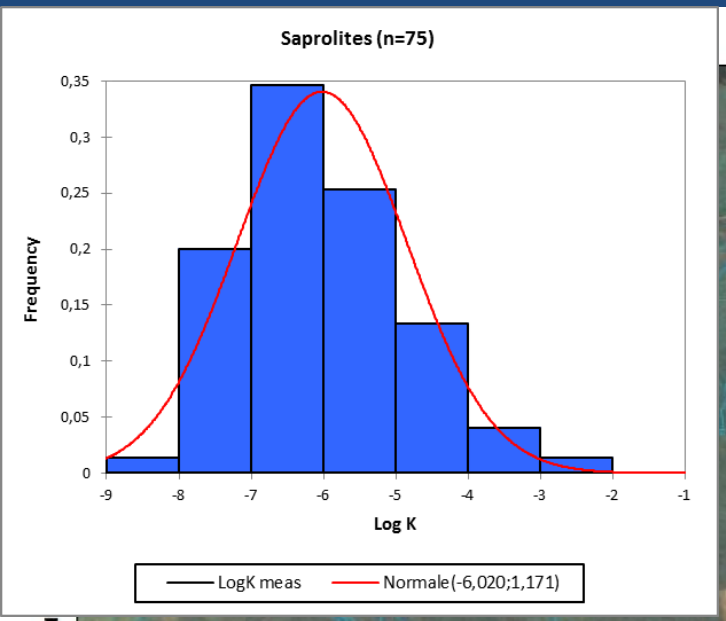
Laterites (n=17)



Mean K of laterites = 10-7 m/s
Low variability

Hydraulic tests

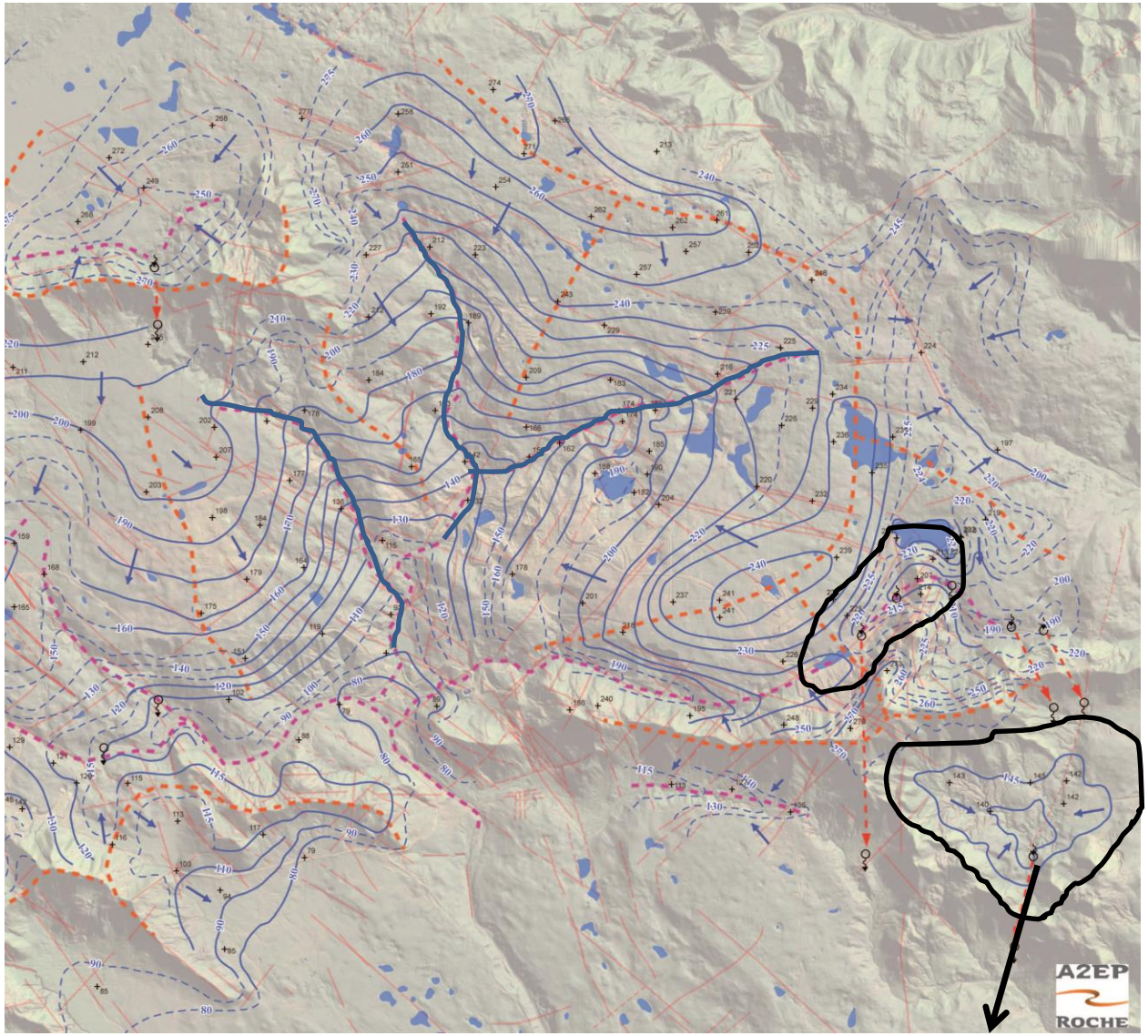
Coarse saprolites and fractured peridotites (n=75)



Mean K of saprolites = 10-6 m/s
High variability over 7 orders

Spatial distribution

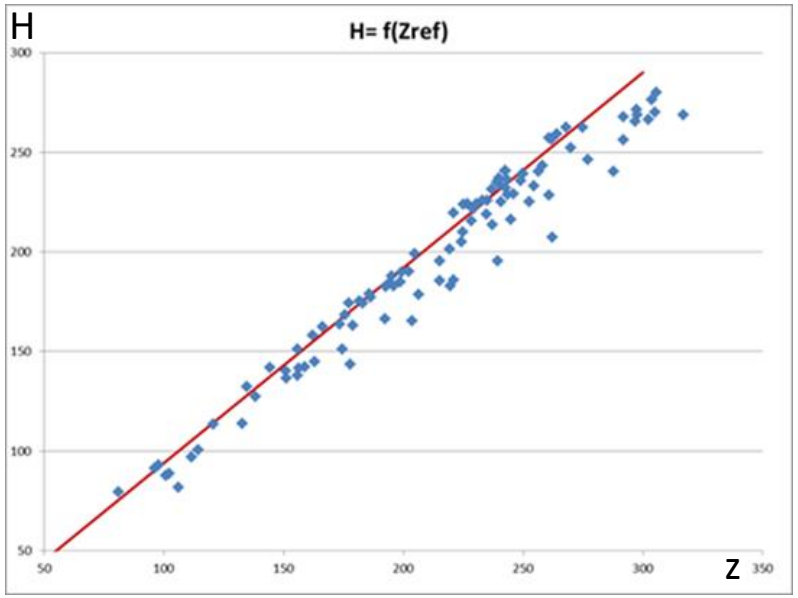
- Focus on coarse saprolites and fractured peridotites
- East and North part of the area
- Piezometric data during low water period



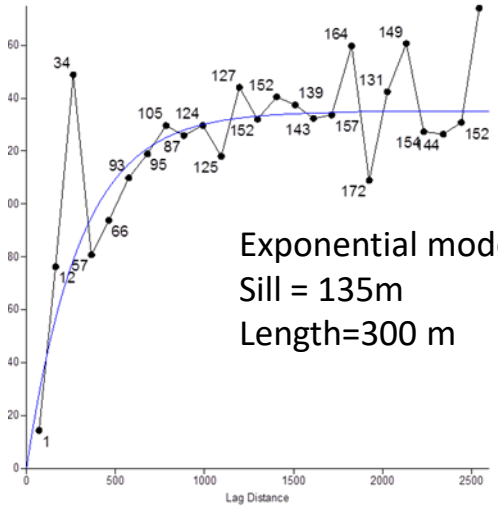
Spatial distribution

- Linear relationship between elevation and hydraulic head

- Hydraulic head reduced from topographic influence

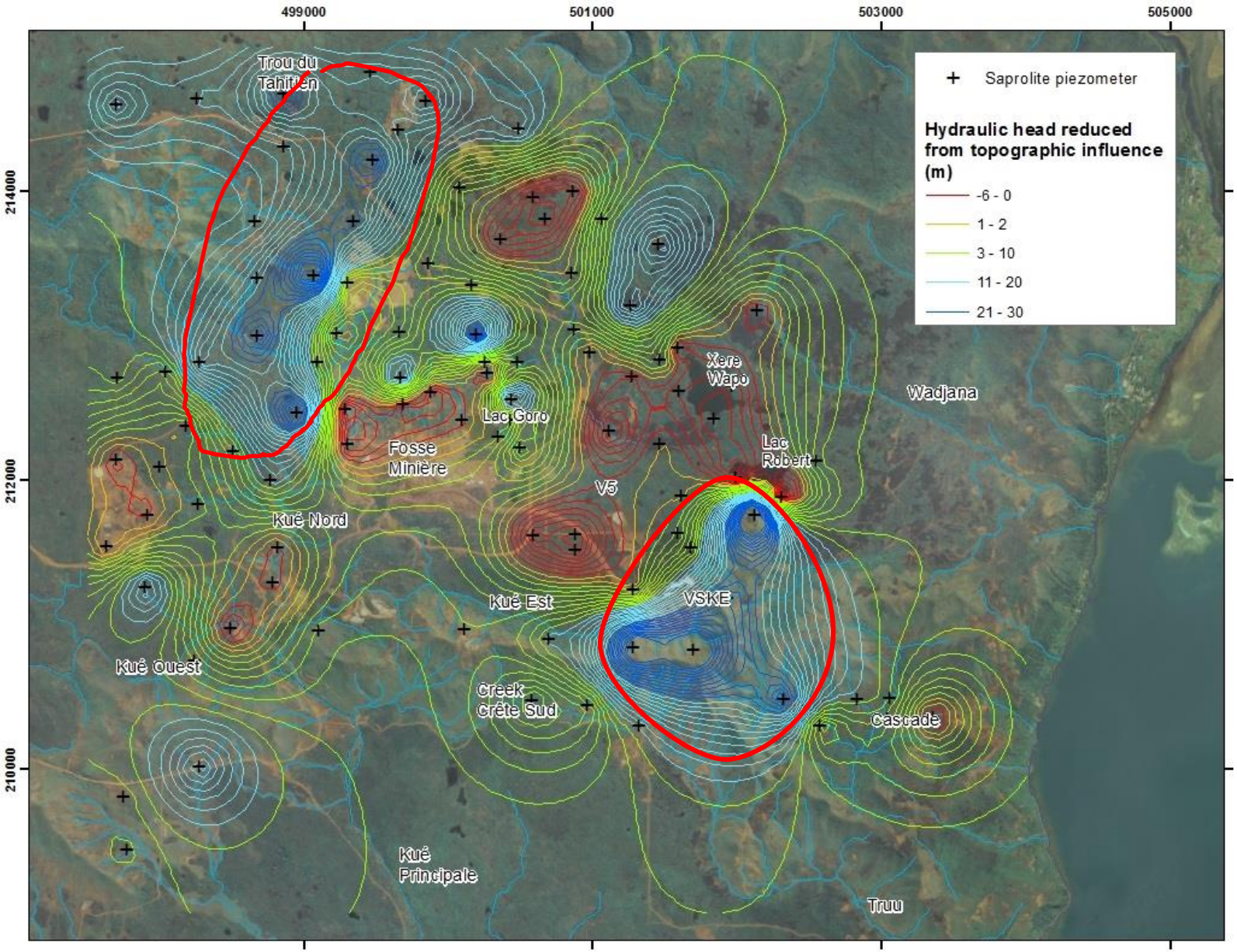


H calc > H measured => well drained area

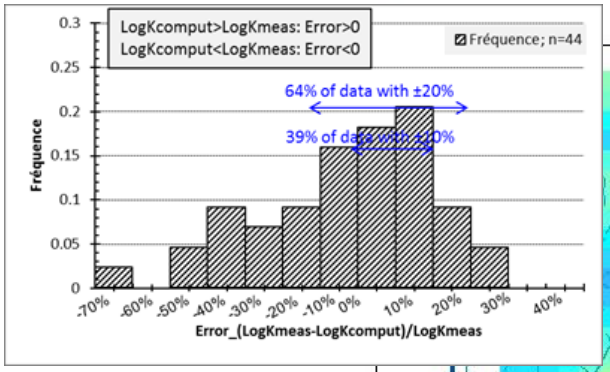


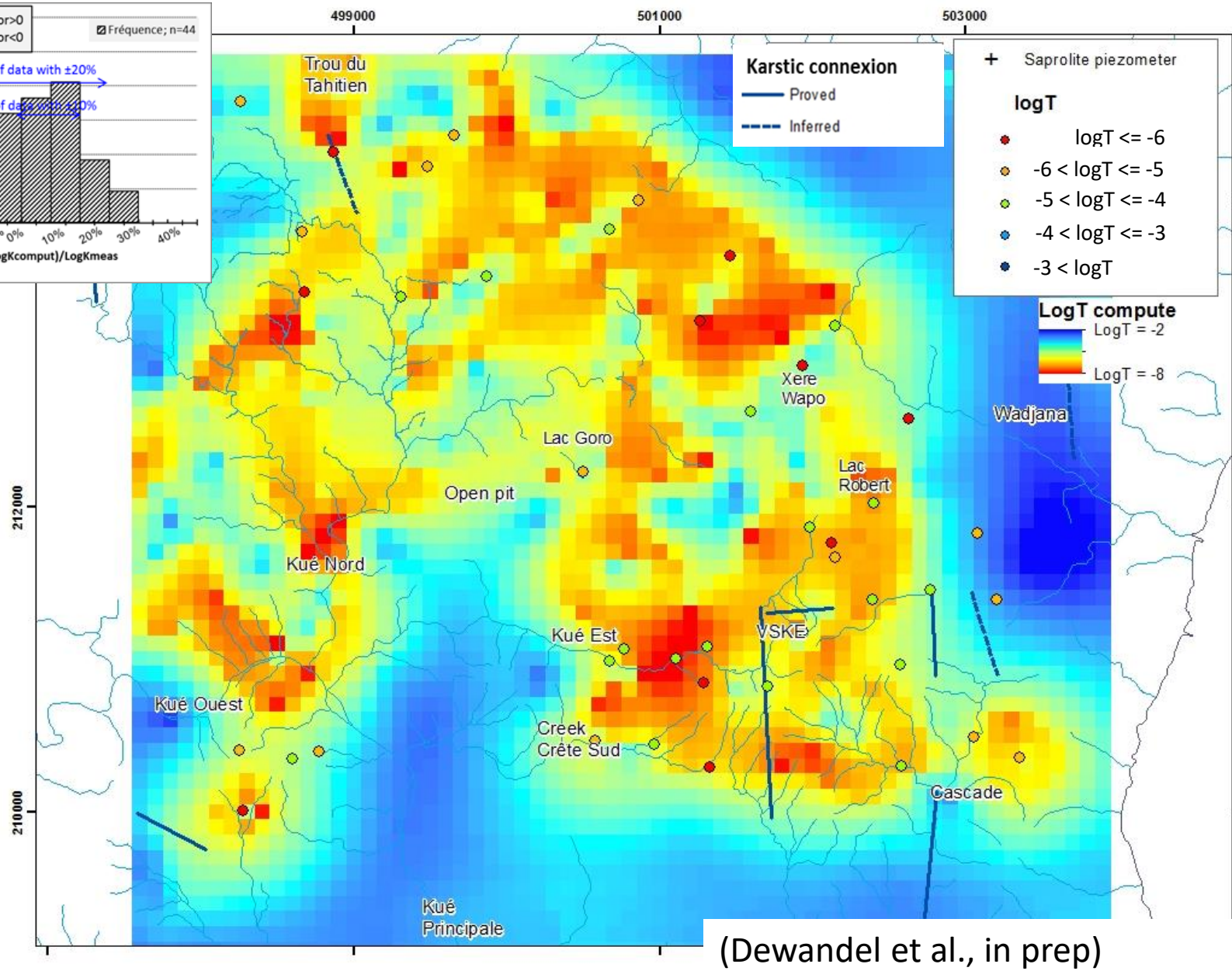
Exponential model :
Sill = 135m
Length=300 m

Spatial distribution



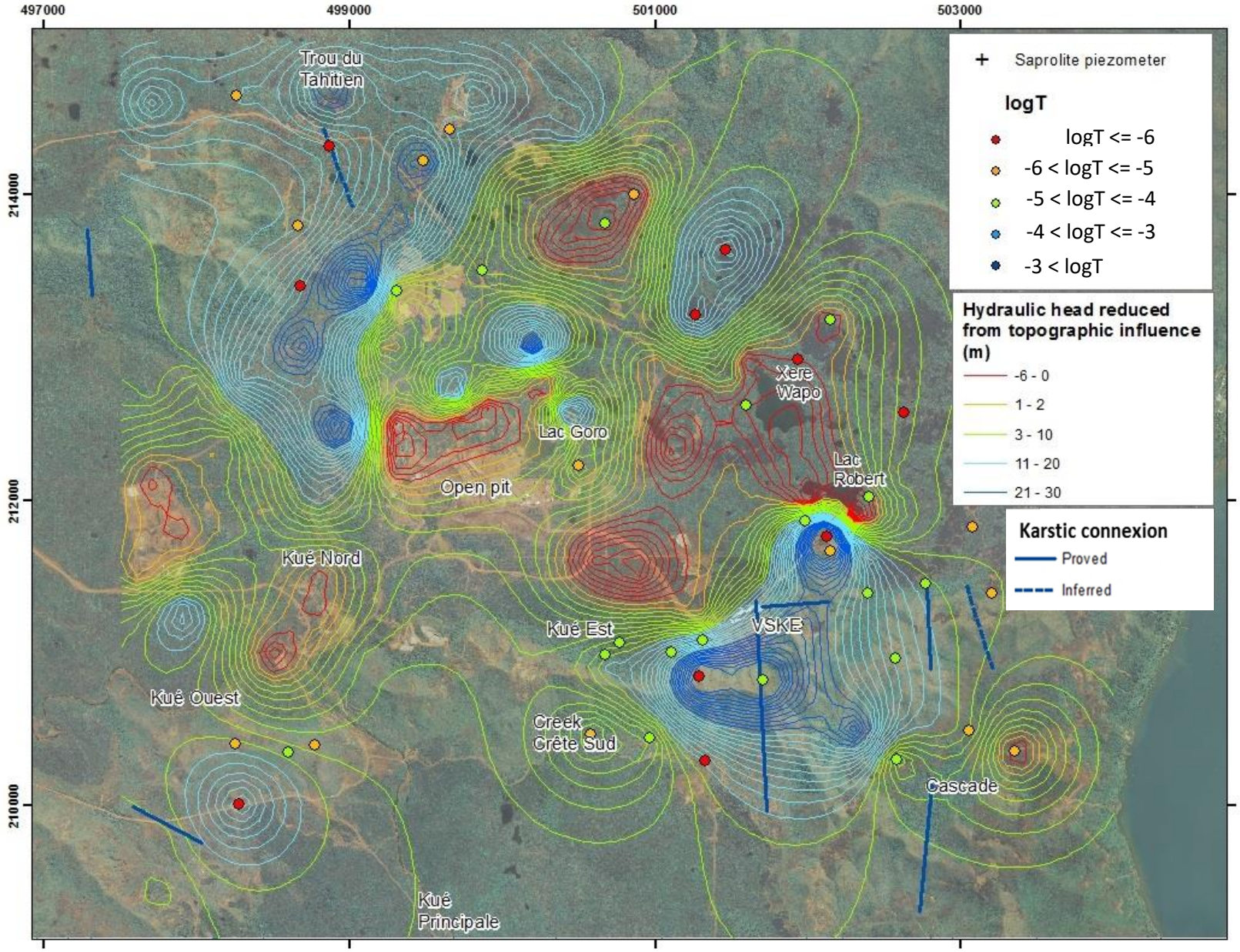
Spatial distribution



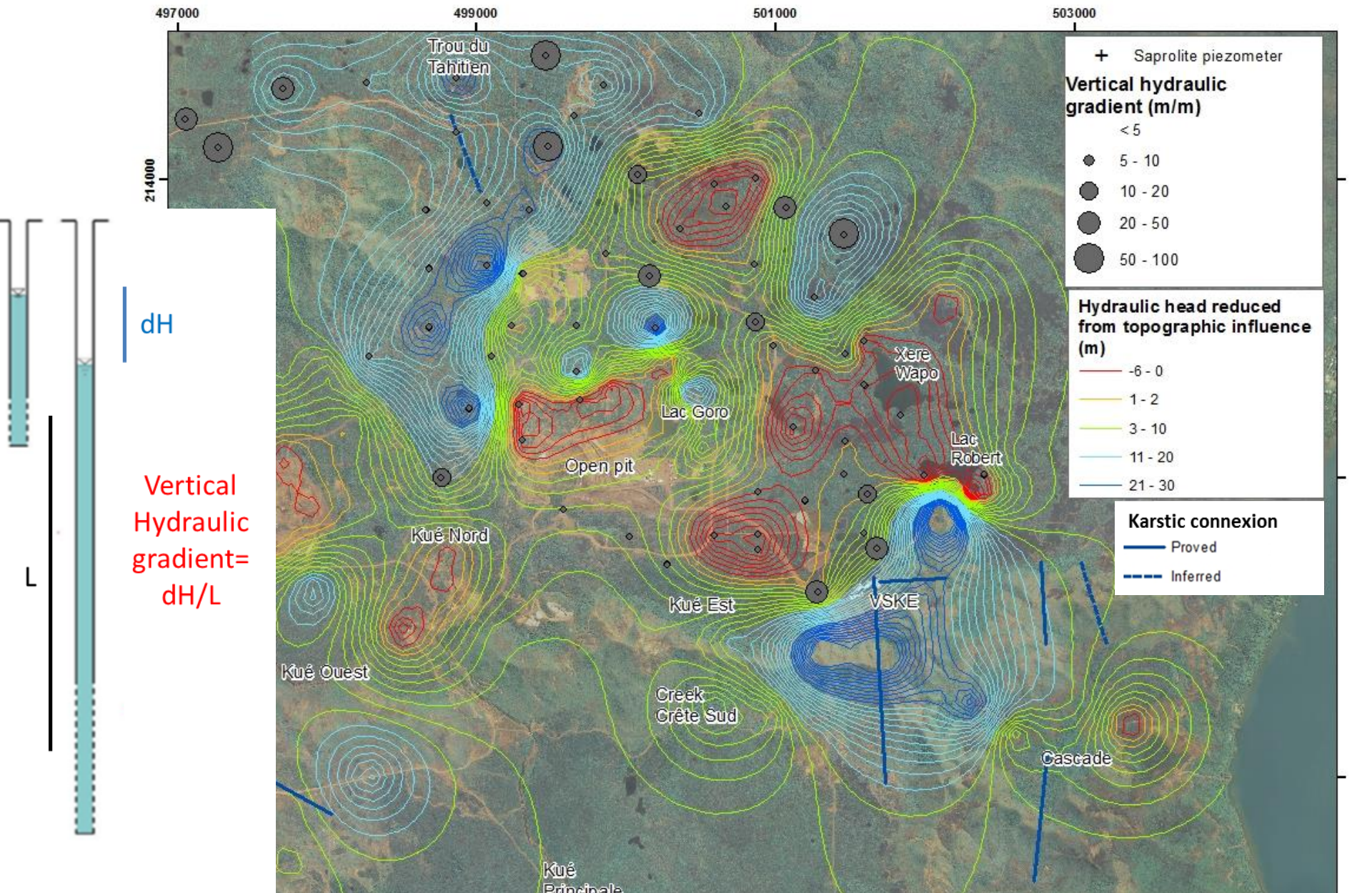


(Dewandel et al., in prep)

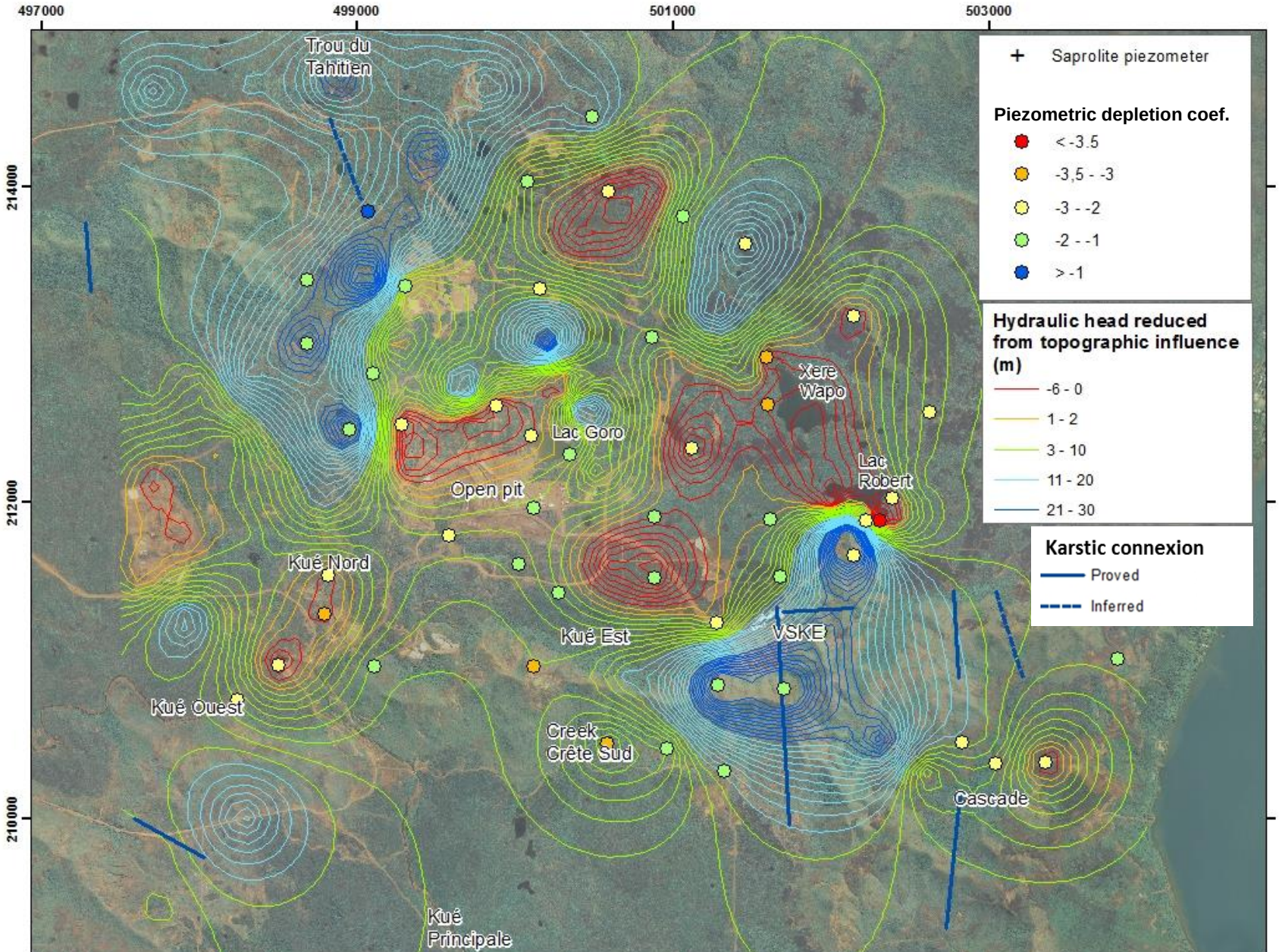
Discussion


497000
499000
501000
503000
214000
212000
210000
Trou du Tahitien
Xere Wapo
Lac Goro
Lac Robert
Open pit
Kué Nord
Kué Est
VSKE
Kué Ouest
Creek Crête Sud
Cascade
Kué Principale
Saprolite piezometer
logT
logT <= -6
-6 < logT <= -5
-5 < logT <= -4
-4 < logT <= -3
-3 < logT
Hydraulic head reduced from topographic influence (m)
-6 - 0
1 - 2
3 - 10
11 - 20
21 - 30
Karstic connexion
Proved
Inferred

Discussion


497000
499000
501000
503000
214000
Trou du Tahitien
Saprolite piezometer
Vertical hydraulic gradient (m/m)
< 5
5 - 10
10 - 20
20 - 50
50 - 100
Hydraulic head reduced from topographic influence (m)
-6 - 0
1 - 2
3 - 10
11 - 20
21 - 30
Karstic connexion
Proved
Inferred
Xere Wapo
Lac Goro
Lac Robert
Open pit
Kué Nord
Kué Est
VSKE
Kué Ouest
Creek Crête Sud
Cascade
Kué Principale
dH
L
Vertical Hydraulic gradient= dH/L

Discussion


497000
499000
501000
503000
214000
212000
210000
Trou du Tahitien
Saprolite piezometer
Piezometric depletion coef.
< -3.5
-3,5 - -3
-3 - -2
-2 - -1
> -1
Hydraulic head reduced from topographic influence (m)
-6 - 0
1 - 2
3 - 10
11 - 20
21 - 30
Karstic connexion
Proved
Inferred
Xere Wapo
Lac Goro
Lac Robert
Open pit
Kué Nord
Kué Est
VSKE
Kué Ouest
Creek Crête Sud
Cascade
Kué Principale

Conclusion

- Laterites are homogenous and semi-impervious
- Hydraulic conductivity of coarse saprolites and fractured peridotites varies on 7 orders : -8 to -2
- Spatial distribution of K shows high permeable structures
- Piezometric data reveal highly drained area by deep structures or karstic connexion

⇒ Deep draining structures in peridotites
⇒ Importance of scaling effect on hard rock / pseudokarstic aquifer

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THANK YOU FOR YOUR ATTENTION…. Questions?

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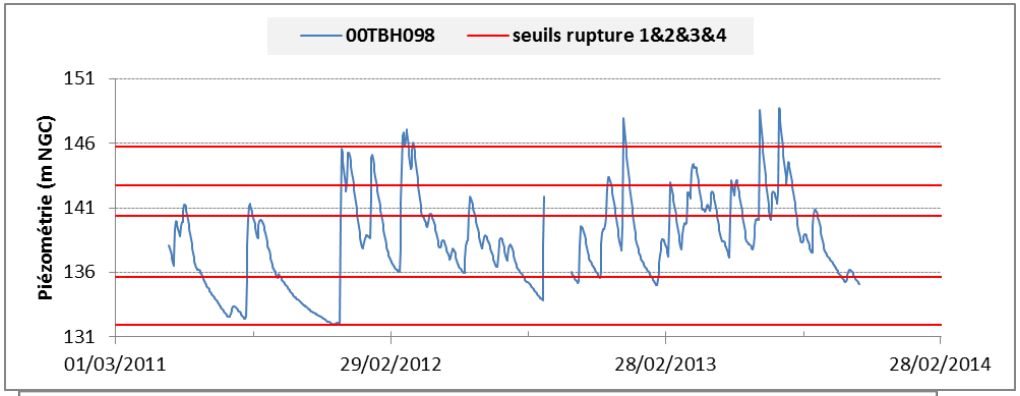
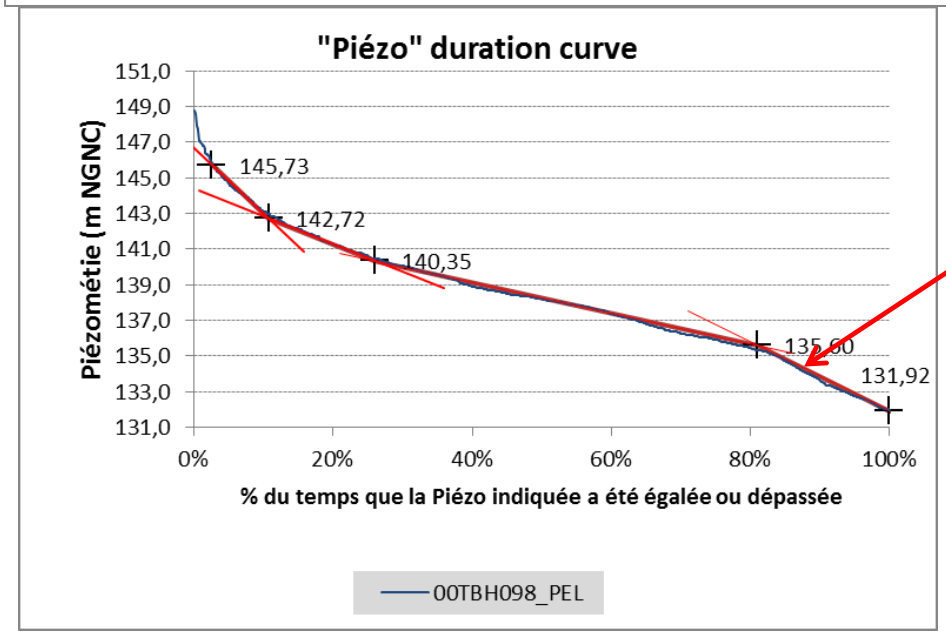
Piezometric depletion coefficient

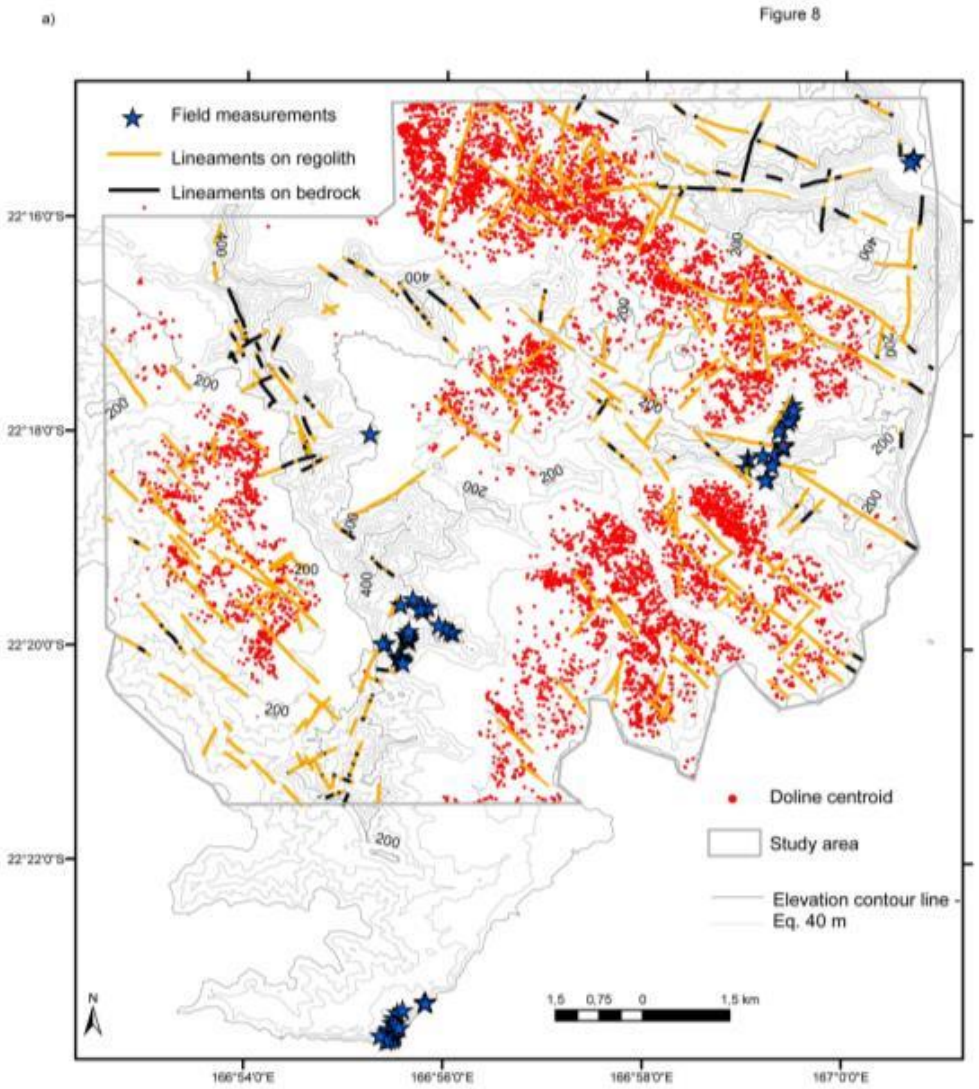
H= f(t) and curve showing the percentage of time during which the GW level of the aquifer is equal to or greater than a given level, regardless of chronological order

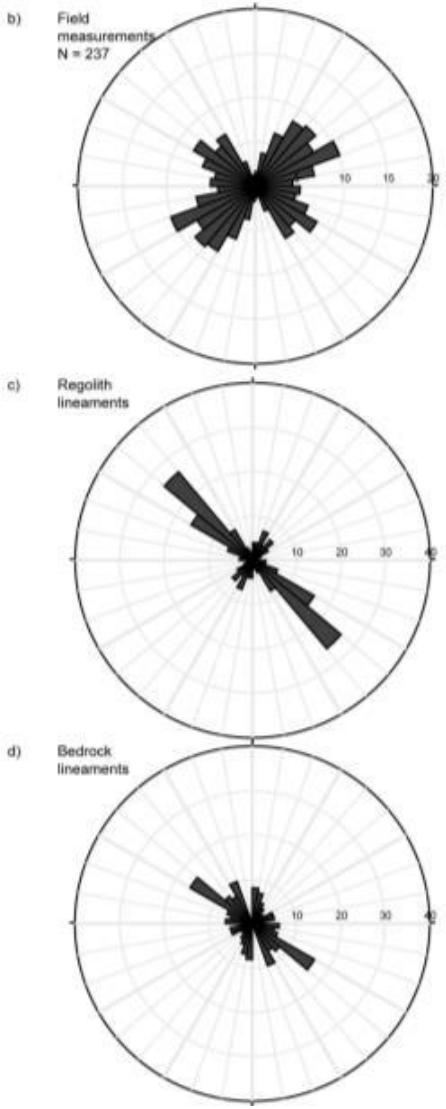




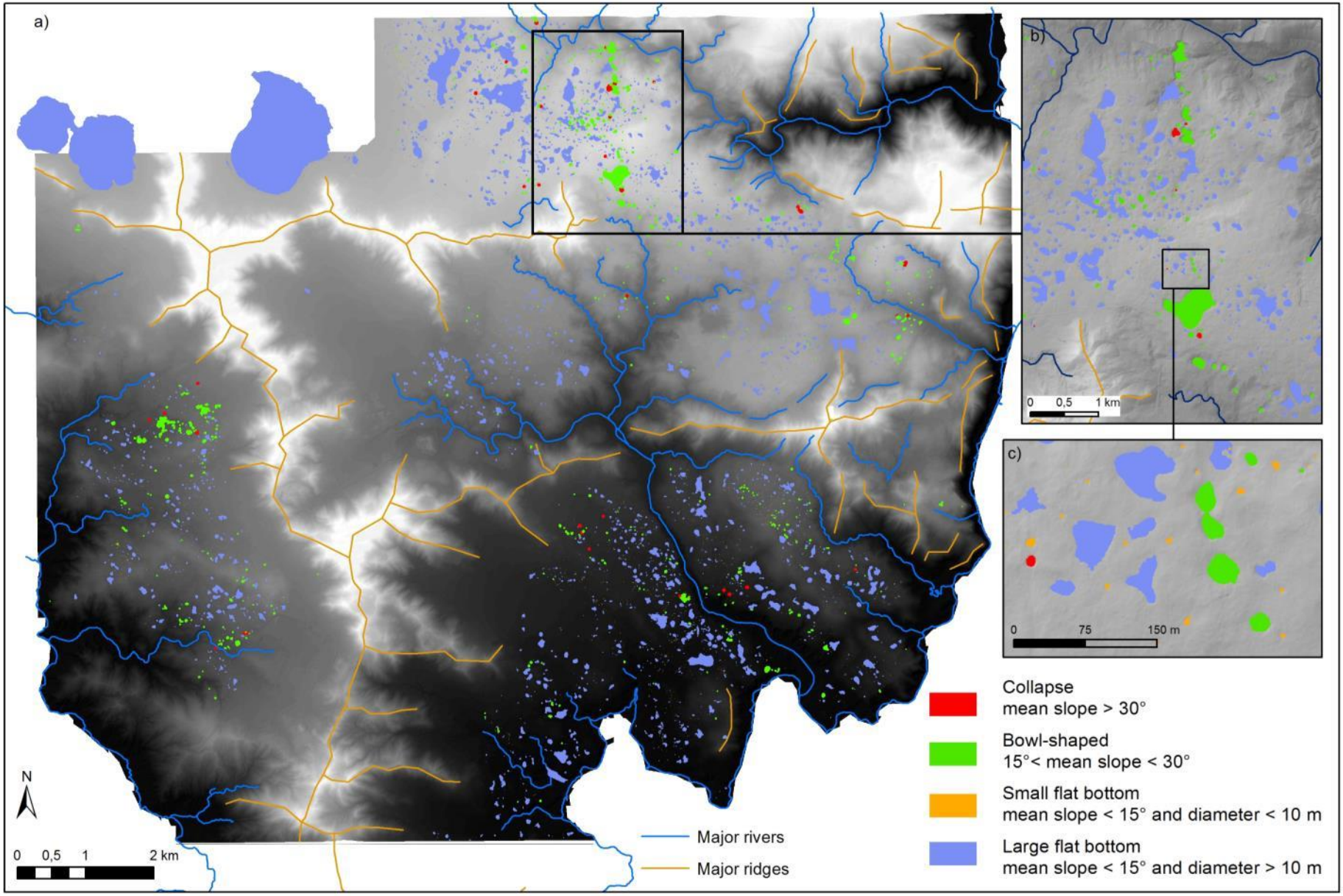
Slope at low water level = depletion coef.

Fracture measurements





Map and typology of dolines



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