

Appendix

Abandonment of solution mining cavern field Zuidwending, The Netherlands
Statement on Hydraulic Fracturing Risk

Evaluation at query points

Extrapolation to cavern wall

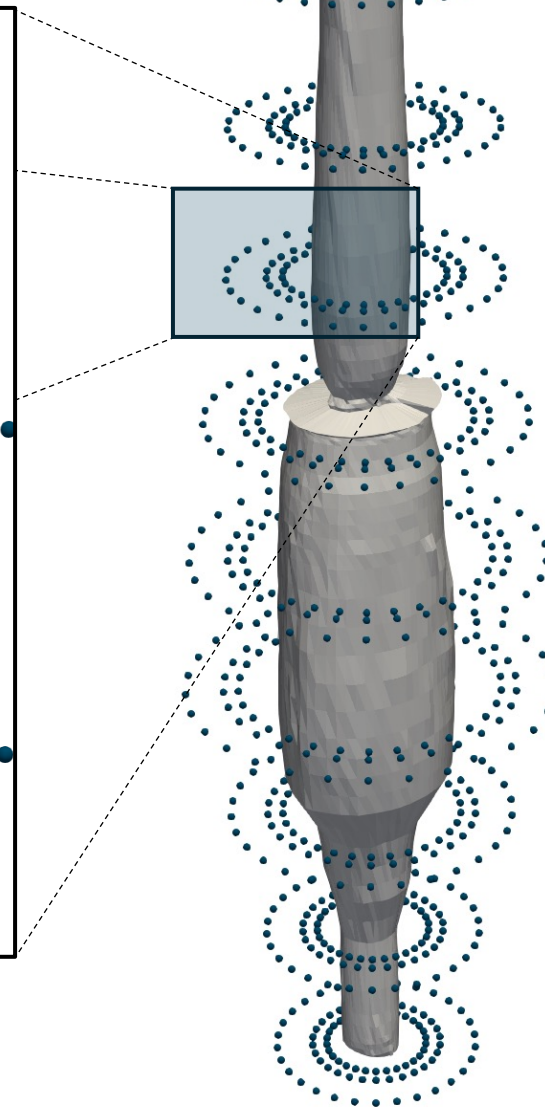
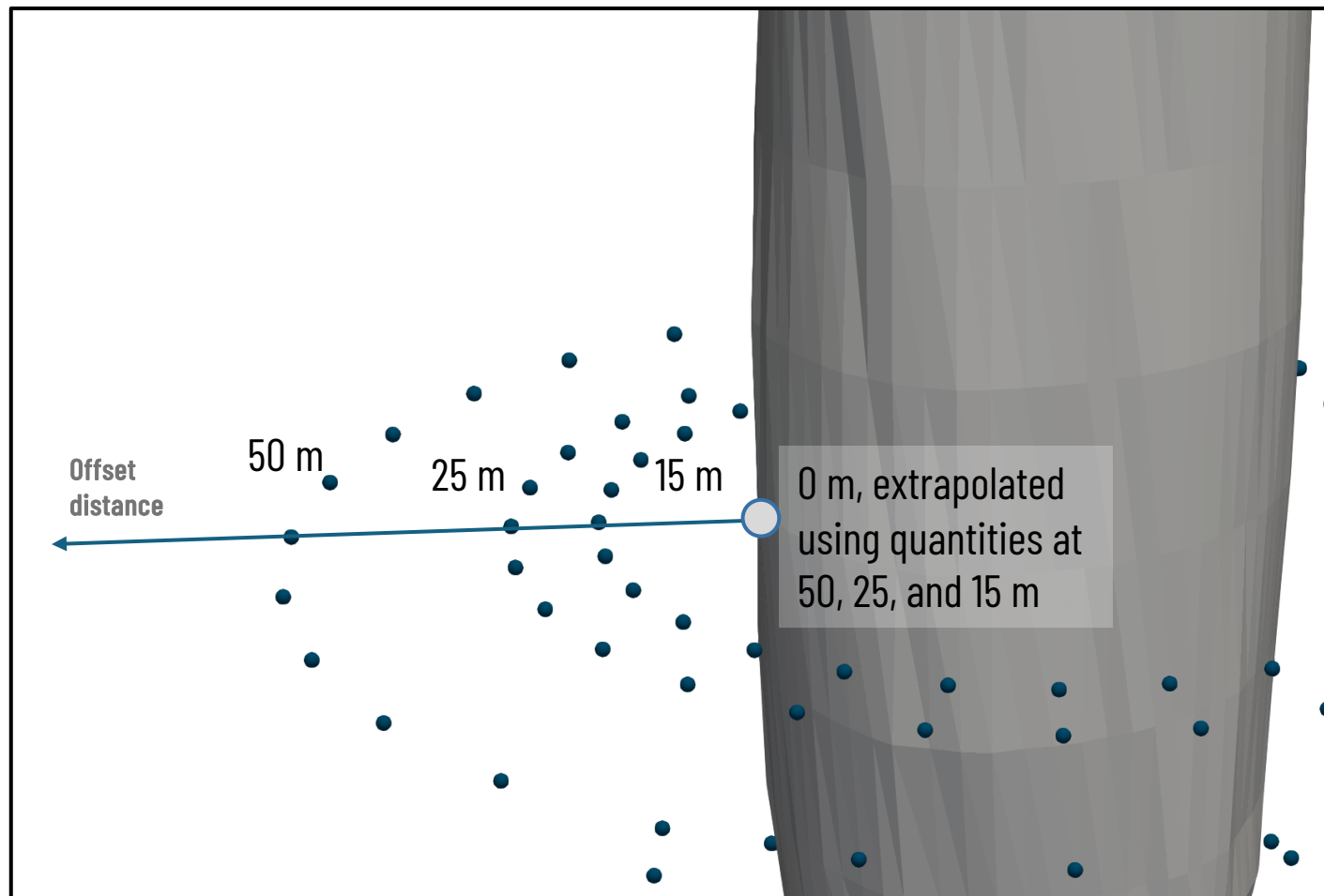


Fig.17

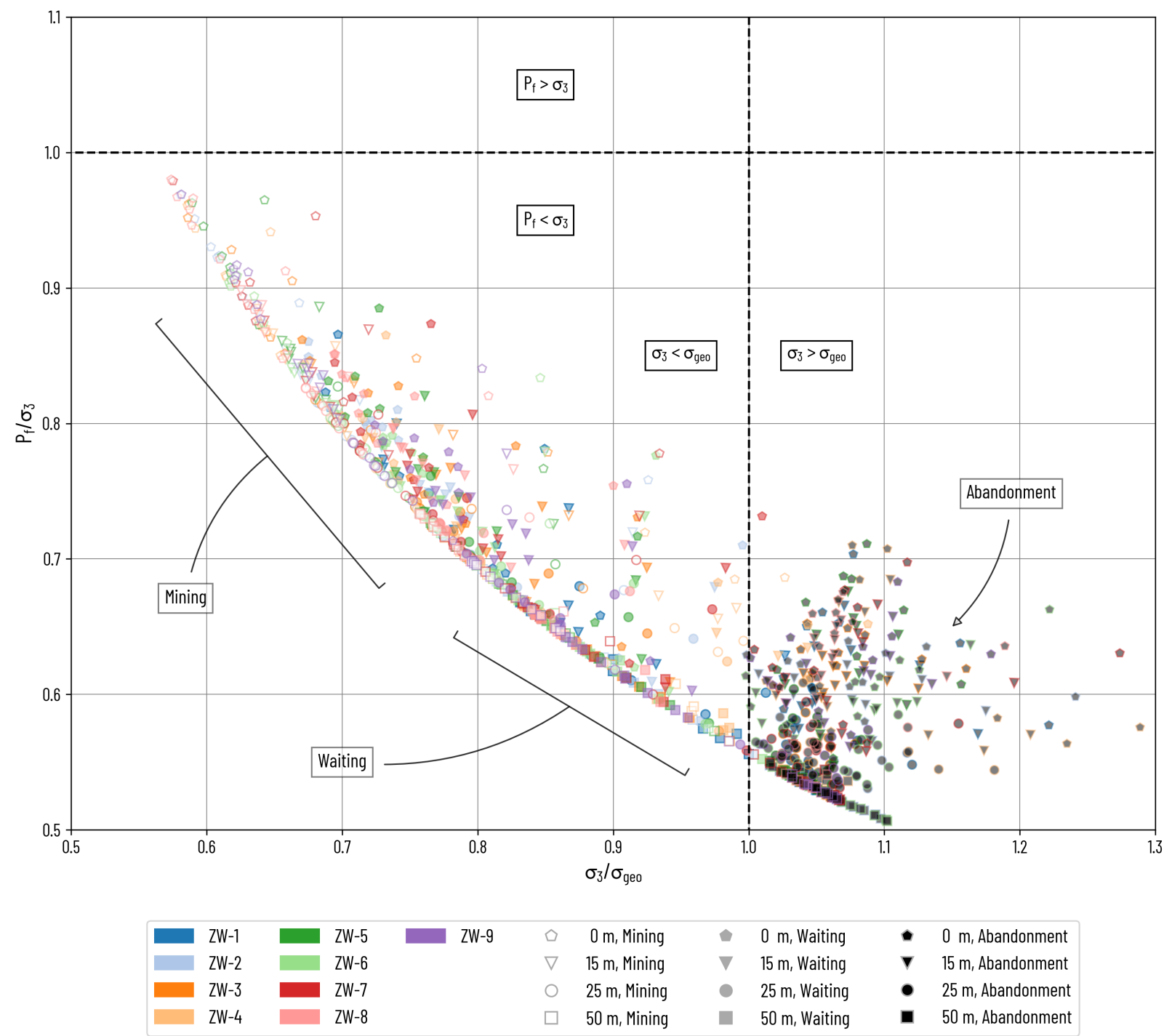


Fig. 18
Focus on 0 m offset

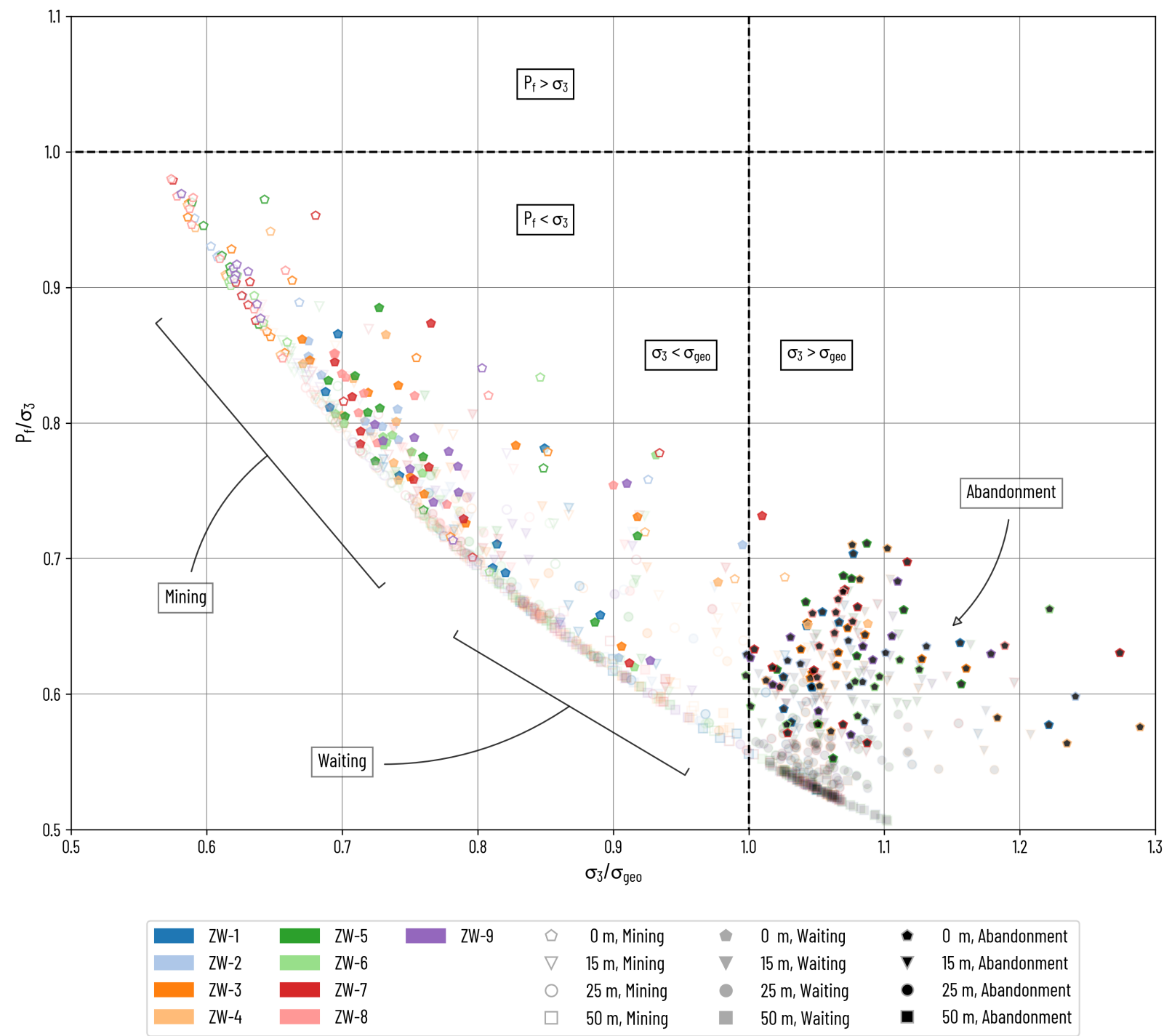


Fig. 18
Focus on 15 m offset

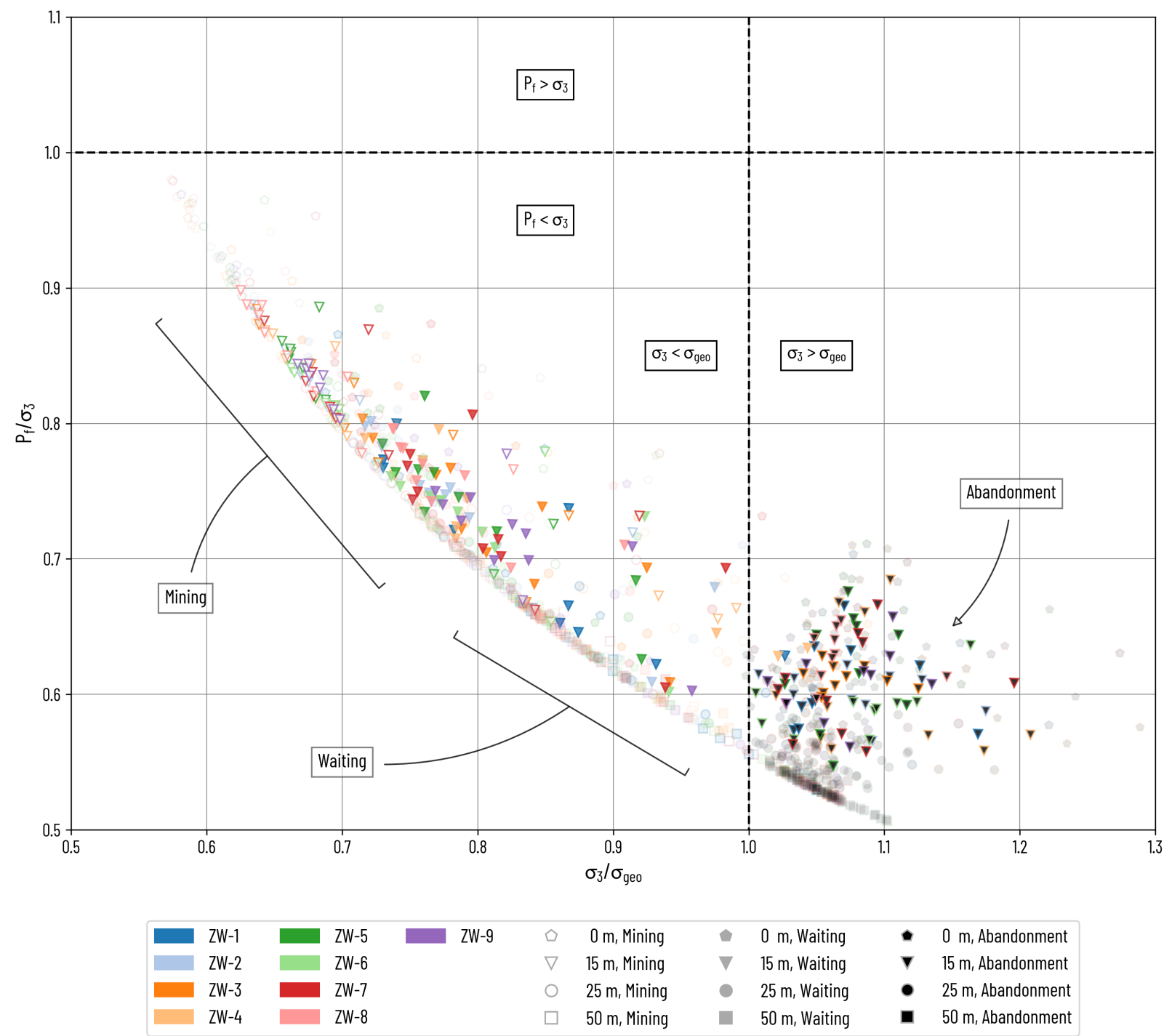


Fig. 18
Focus on 25 m offset

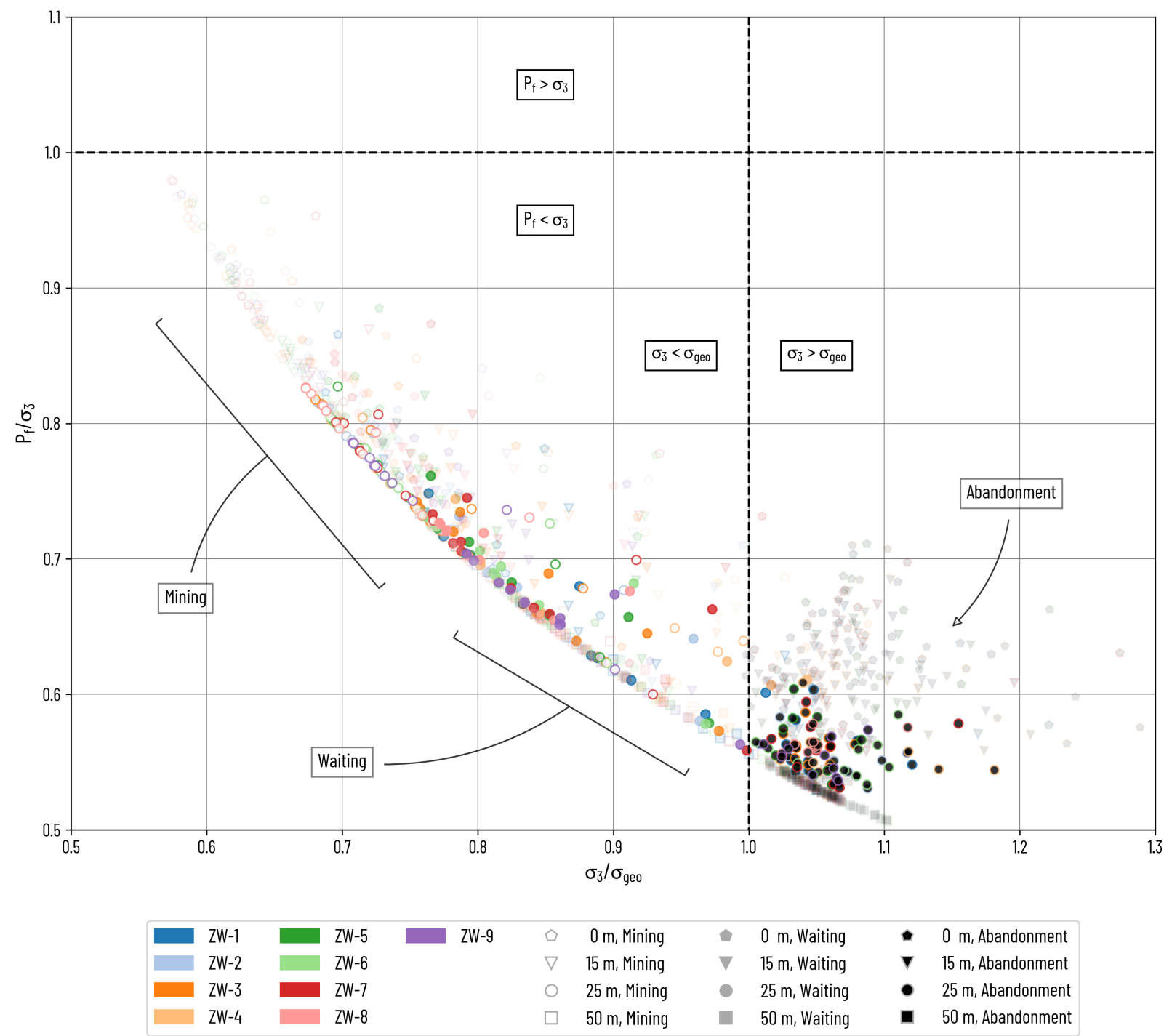


Fig. 18
Focus on 50 m offset

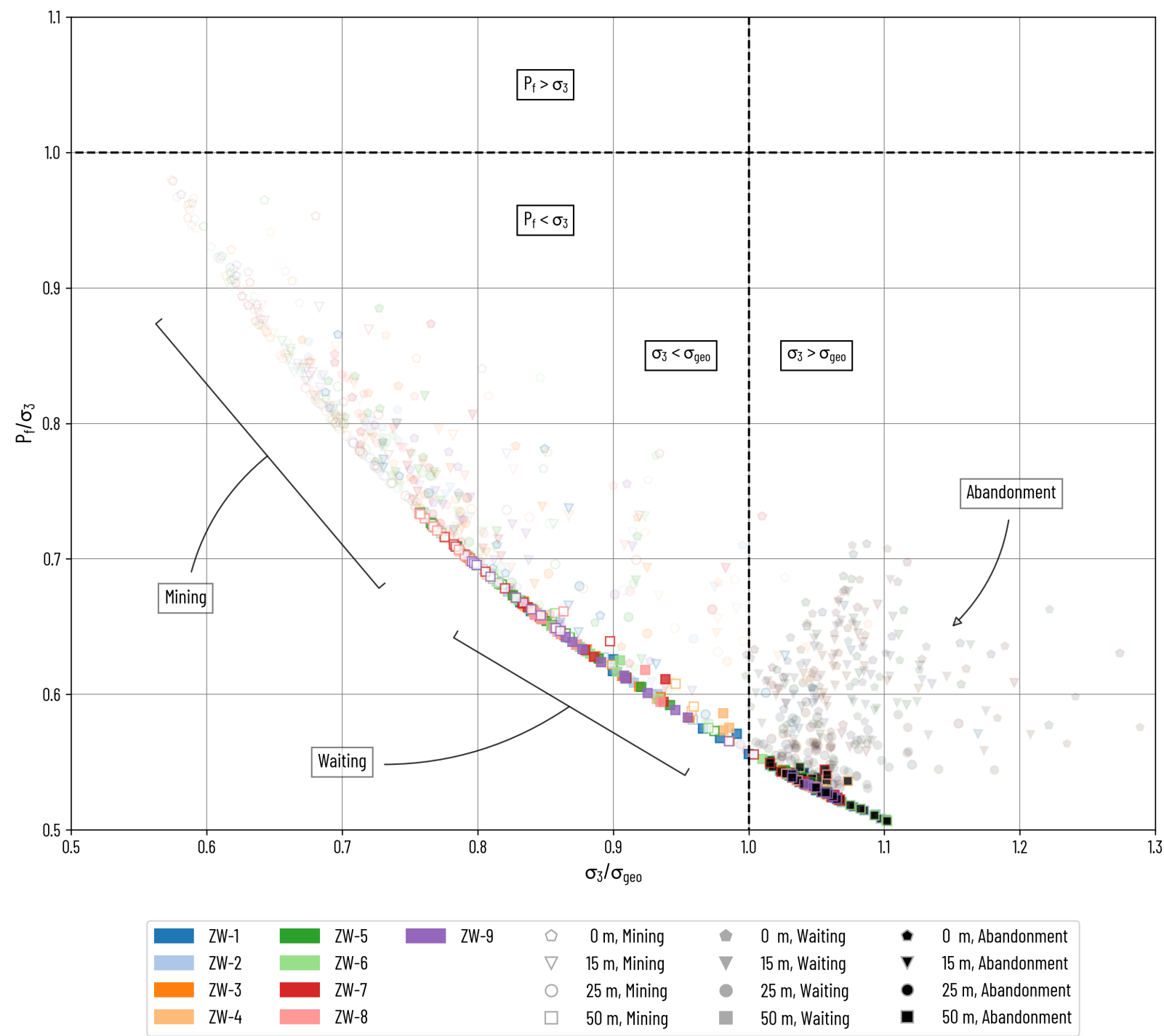


Fig. 19

ZW-6 Focus on 0 m offset

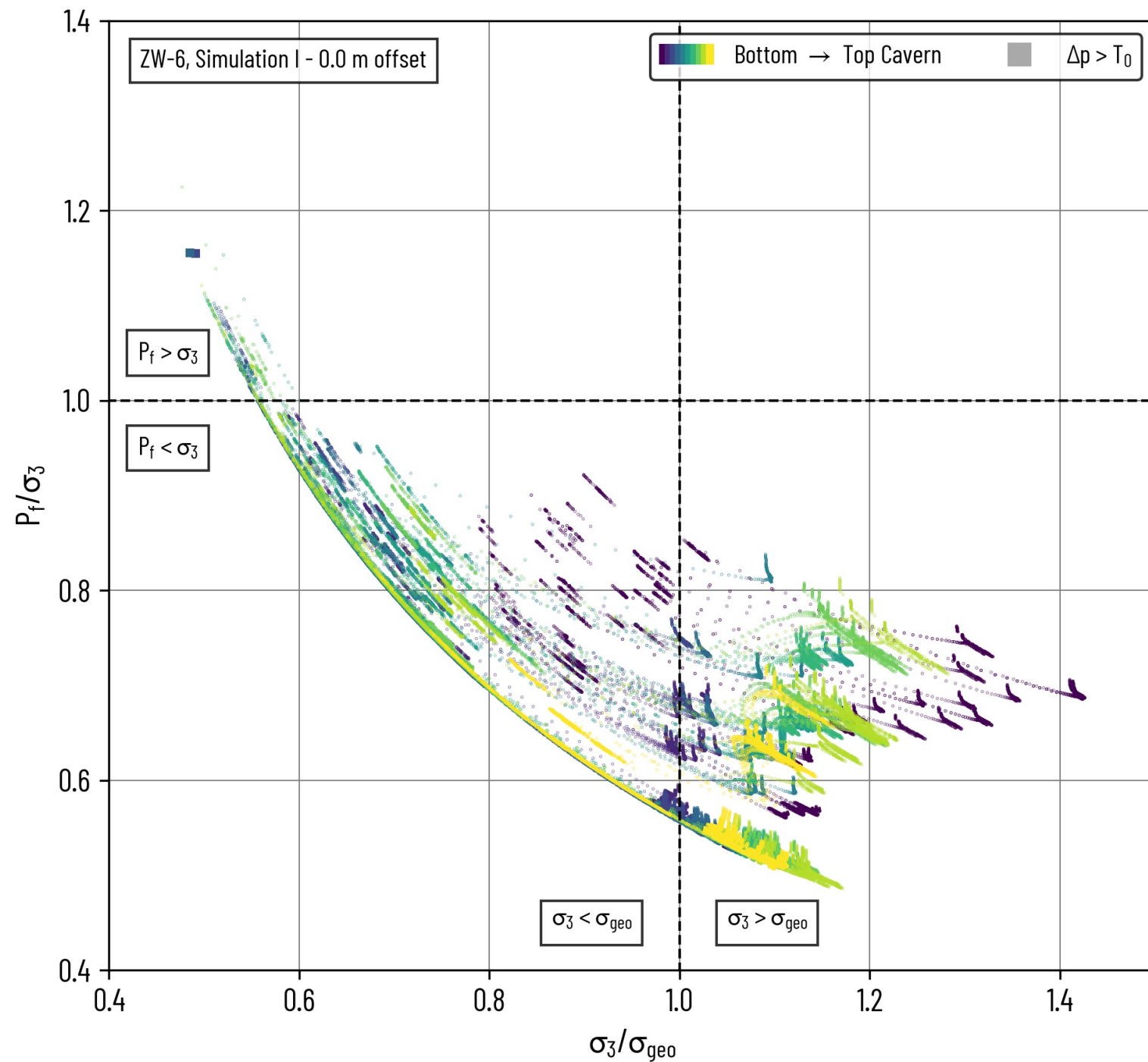


Fig. 19

ZW-6 Focus on 15 m offset

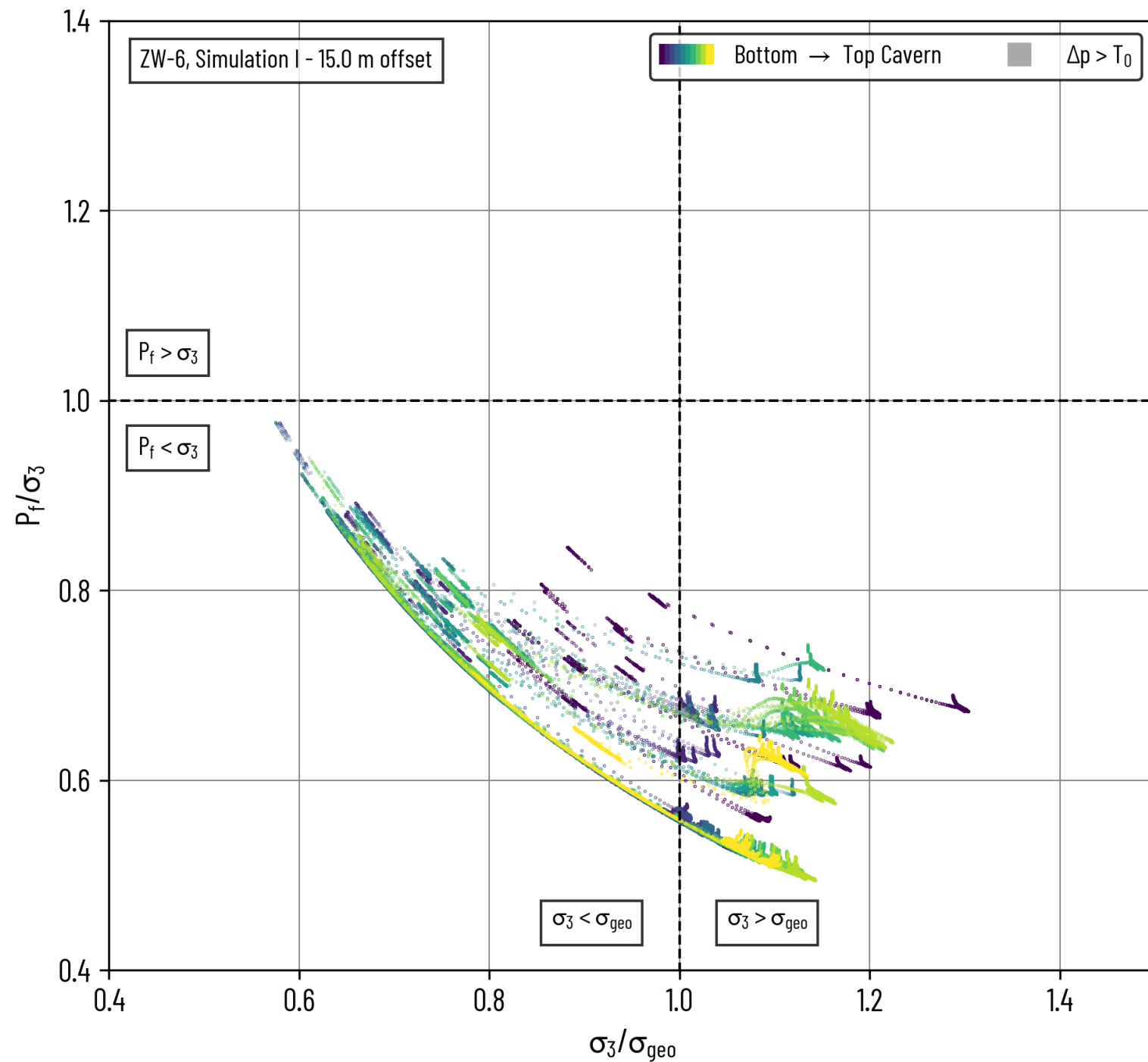


Fig. 19

ZW-6 Focus on 25 m offset

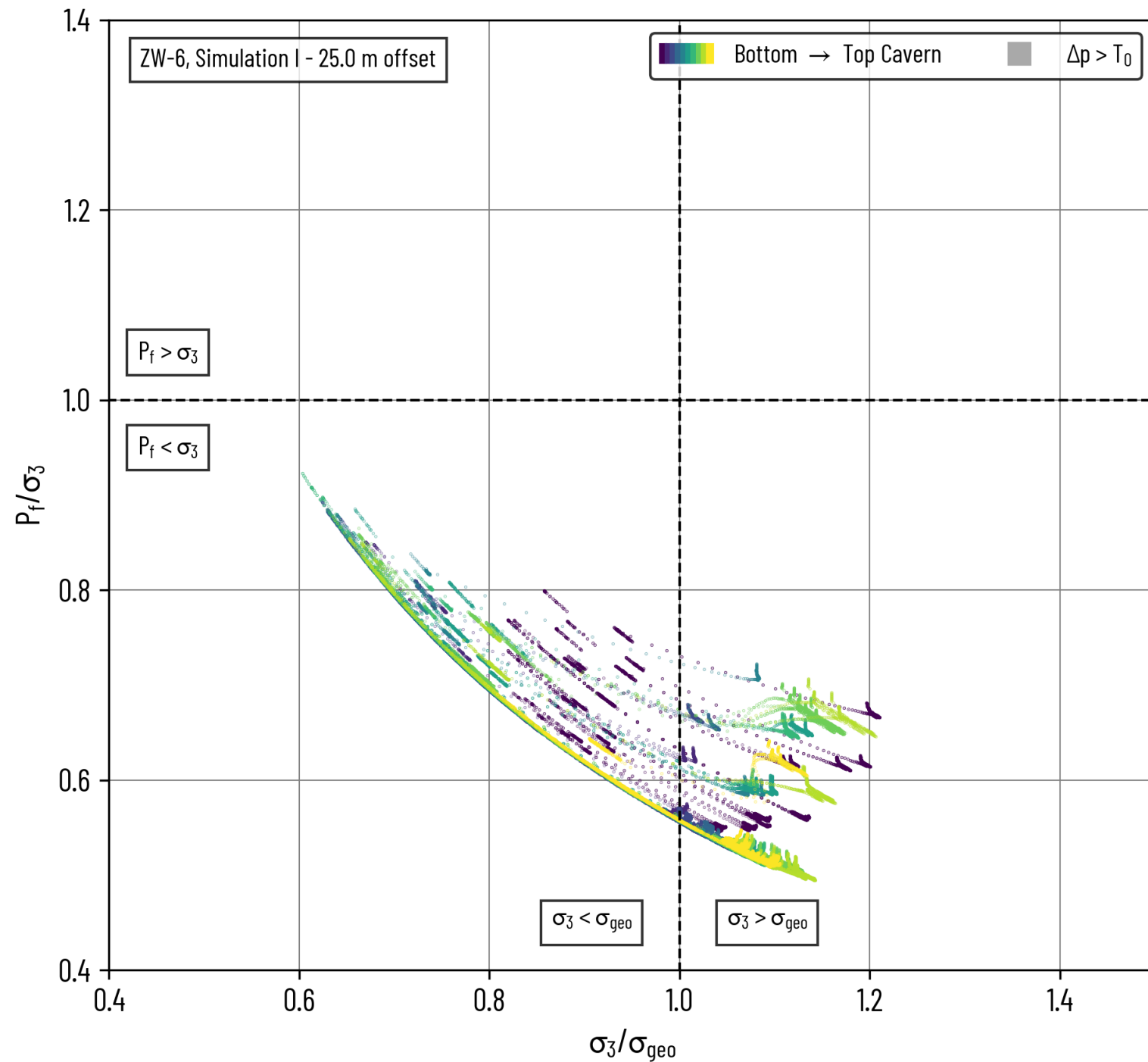
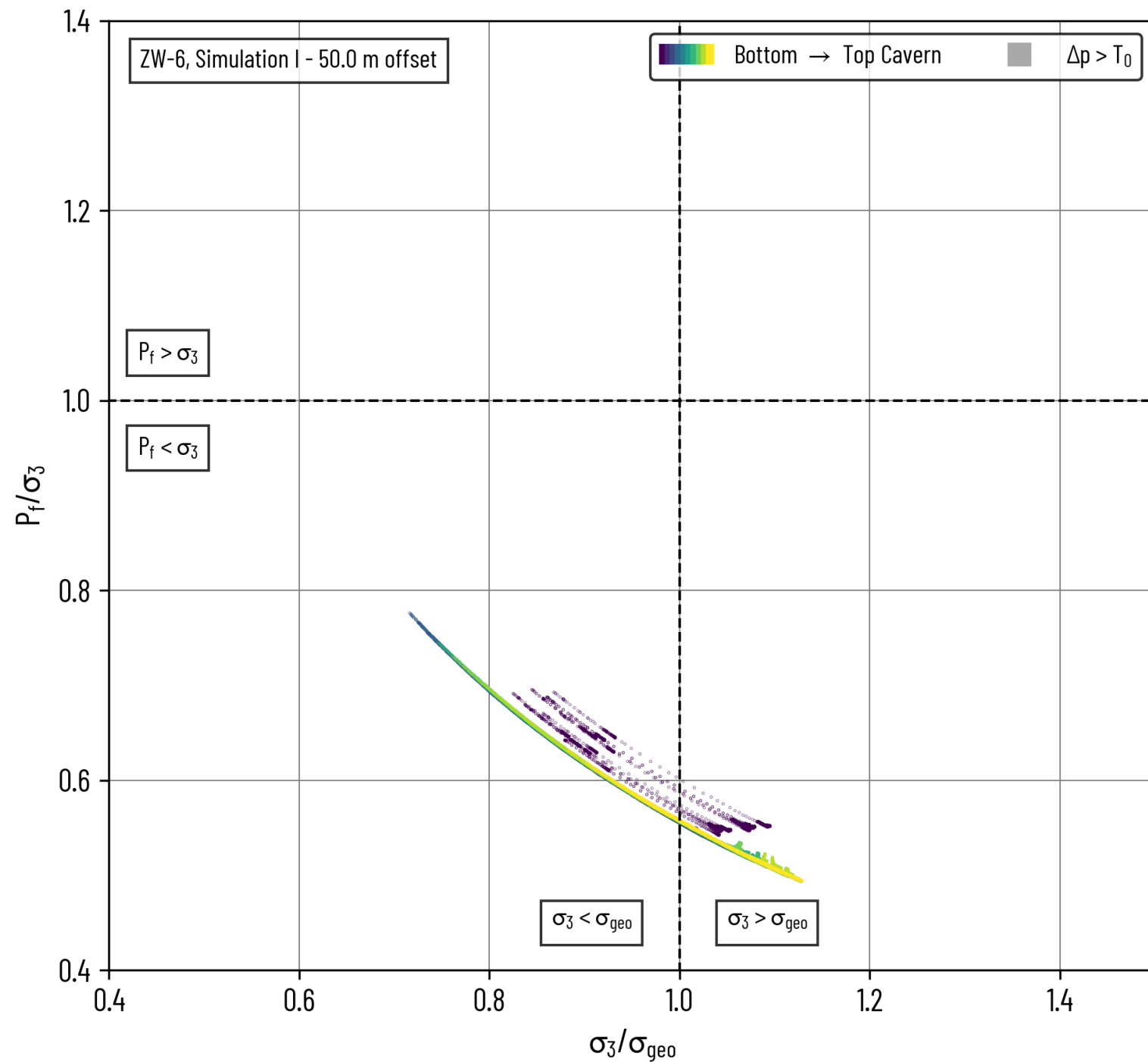


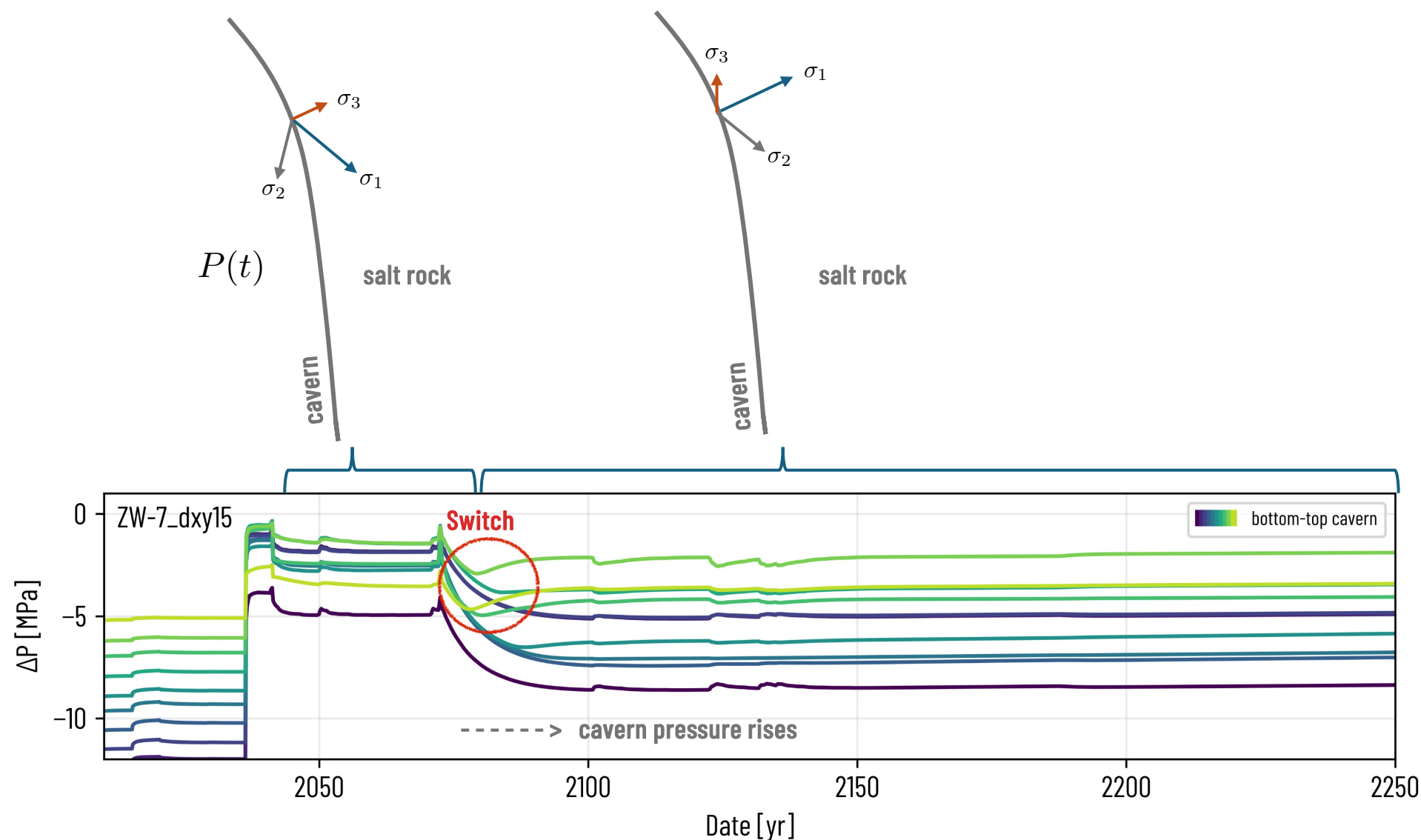
Fig. 19

ZW-6 Focus on 50 m offset



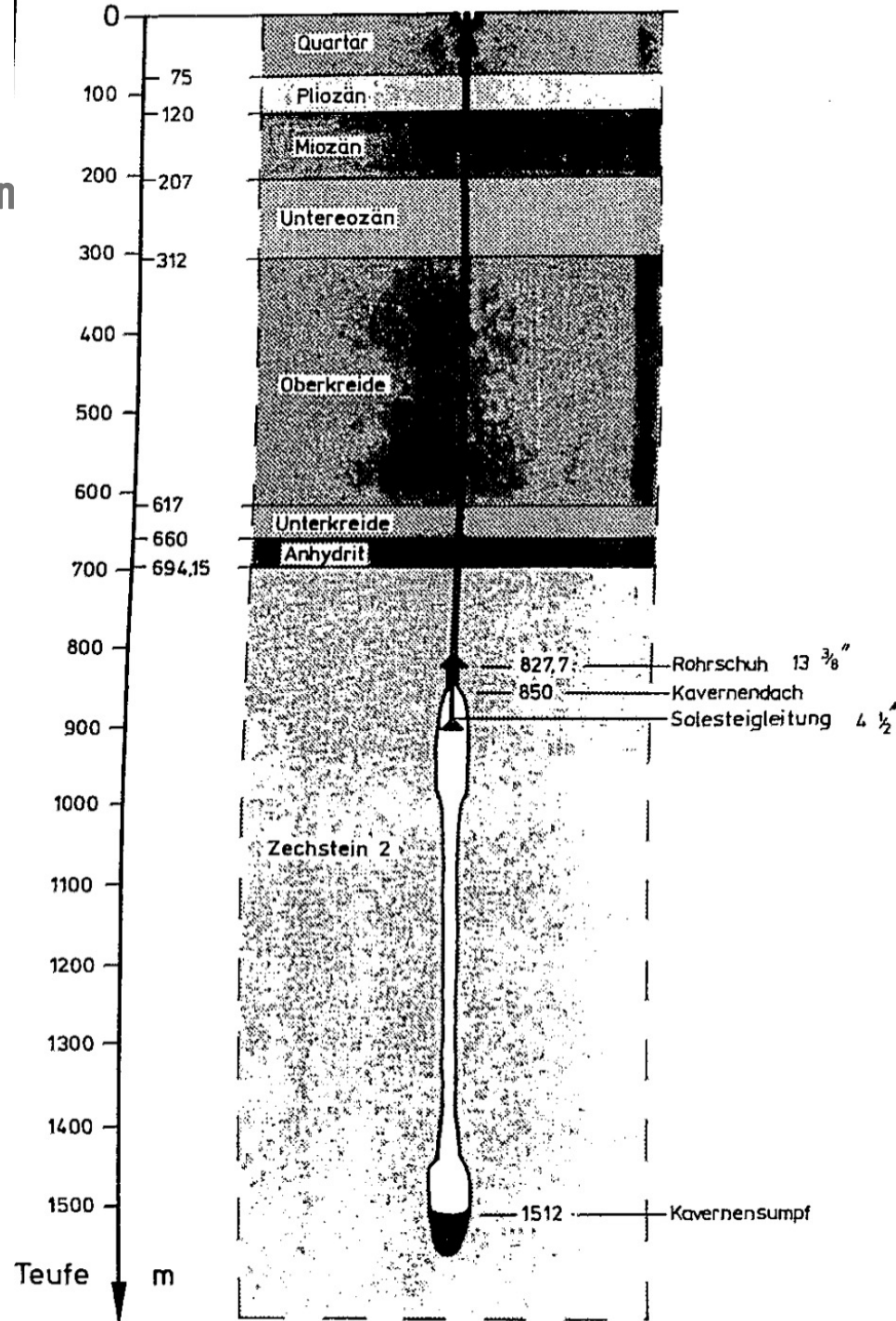
Least compressive stress in the vicinity of the cavern wall

How does it change over the life cycle of the cavern?



Etzel-Test

Seismo-acoustic observation



3-Komponenten-Geophon 1 in Teufe 774,5 m

3-Komponenten-Geophon 2 in Teufe 812,2 m

Hydrophon 1 in Teufe 851,8 m

Hydrophon 2 in Teufe 901,7 m

Typ H1 : Ersteinsatz am Hydrophon 1

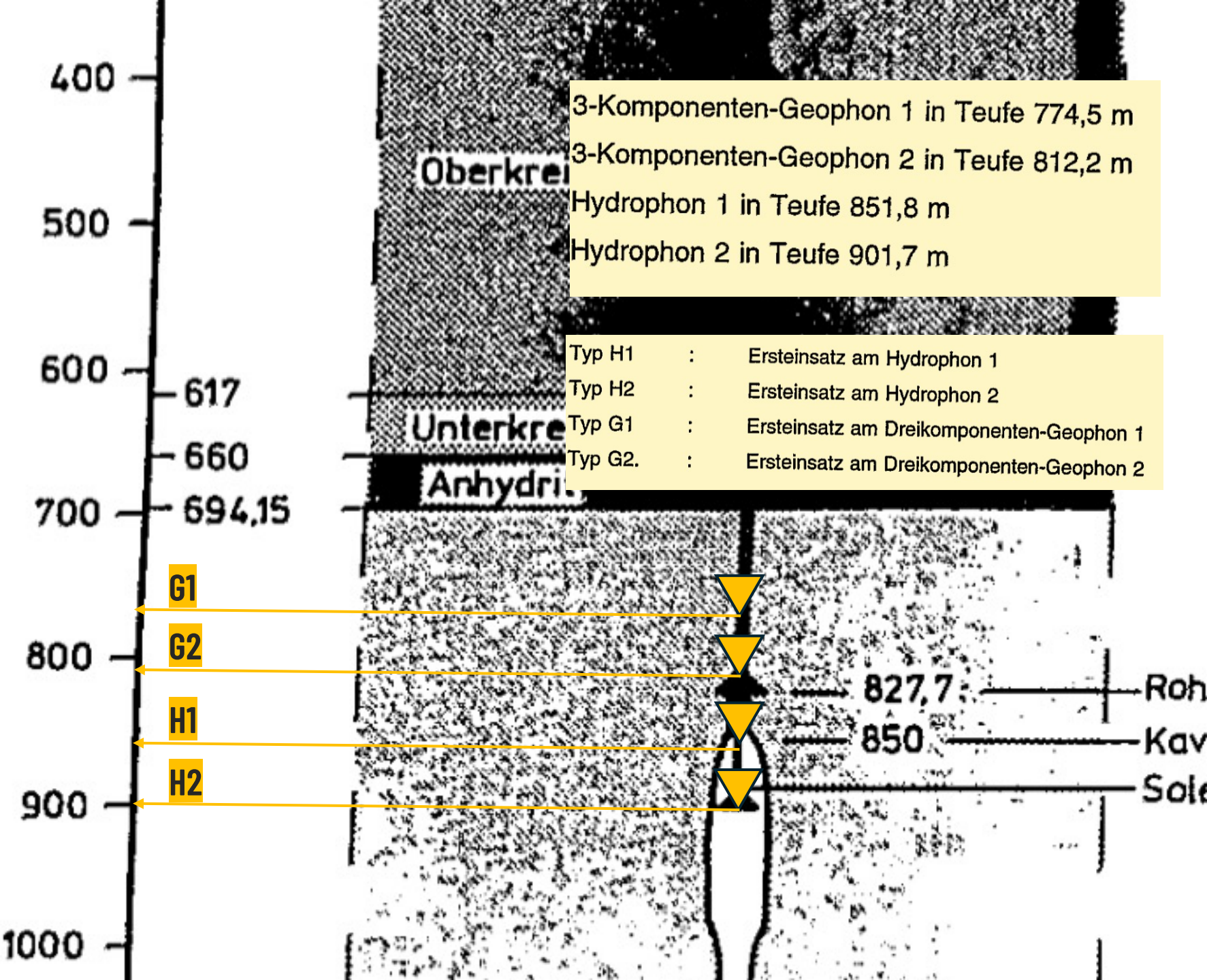
Typ H2 : Ersteinsatz am Hydrophon 2

Typ G1 : Ersteinsatz am Dreikomponenten-Geophon 1

Typ G2. : Ersteinsatz am Dreikomponenten-Geophon 2

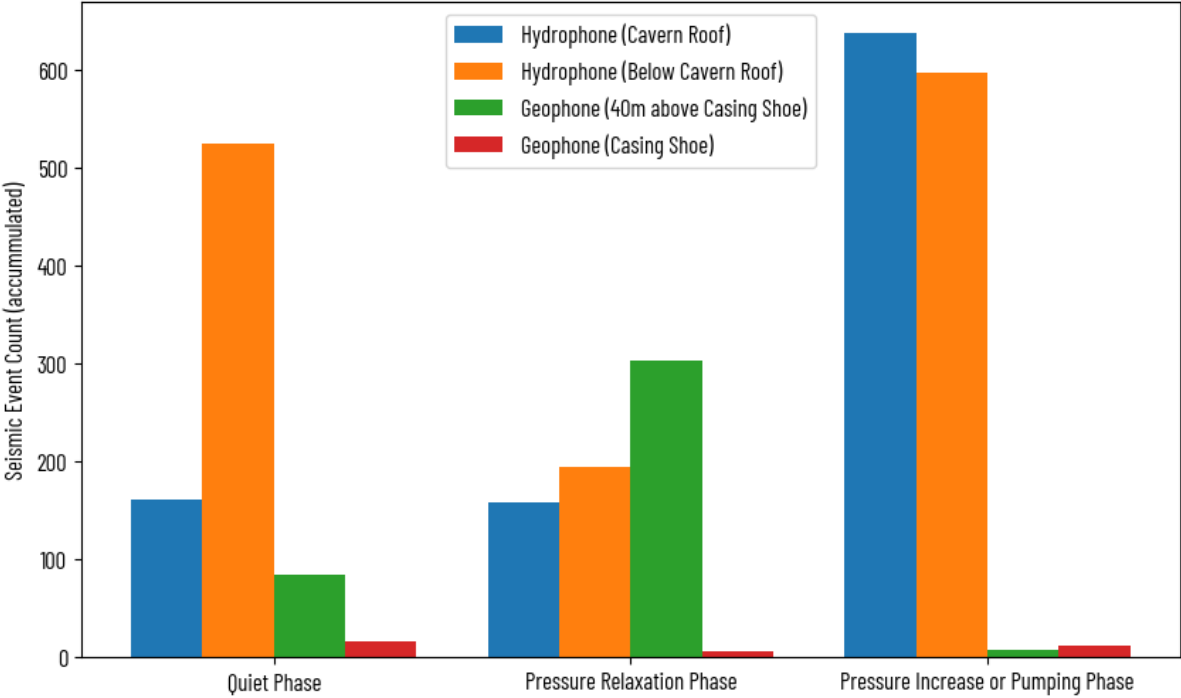
Etzel-Test

Setting



Etzel-Test, K102

Seismo-acoustic observations



Test-Phase	H1	H2	G1	G2	
PP1		3			
QP1	31				H1>R ??
PP2	19				1st 6 events in a row at H1
QP2	10				
PP3	19	53			1st event at H2
QP3	1	21			21 events within 35 sec at H2
PP4	594	469	3	9	1st G2 event with characteristic high frequency content, little seismoacoustic activity. Shortly after G2 event: 2 lowfrequency events registeredat both hydrophones -> localized at K103 cavern
PP4_Q	17	32			Pressure reduction phase:Event series with 49 events in 320s at H1/H2, 17 at H1, then 32 at H2
PP4_R					1 1st G1 event 3.11.91
V1	5	13	2		
V2-R	1	2	112	0	
V2-QP	13	6	0	0	
V2-PP	3	0	1	2	
V2-QP	0	6	0	0	
V3-R	130	135	75	0	Many event cluster < 1min
V3-QP	55	221	0	0	
V3-R	18	56	48	2	
V3-QP	15	47	4	0	
V3-R			49	32	New LOW freq, events at G1, Knistergeräusche "uncorrelated" noise at H1
V3-QP	8	53	34	16	Many low frequent events!
V3-R	9	1	69	3	Many Tremors over several minutes
V3-QP	8	16	0	0	
V4-PP		76	3	1	
V4_QP	4	123	47	0	