Chemical monitoring of the Atotsugawa Fault zone by using new designed QMS

Crustal Fluid Research Group
(Tokyo University)

Members in Crustal Fluid Research Group

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Seismicity in North-Western part of Japan

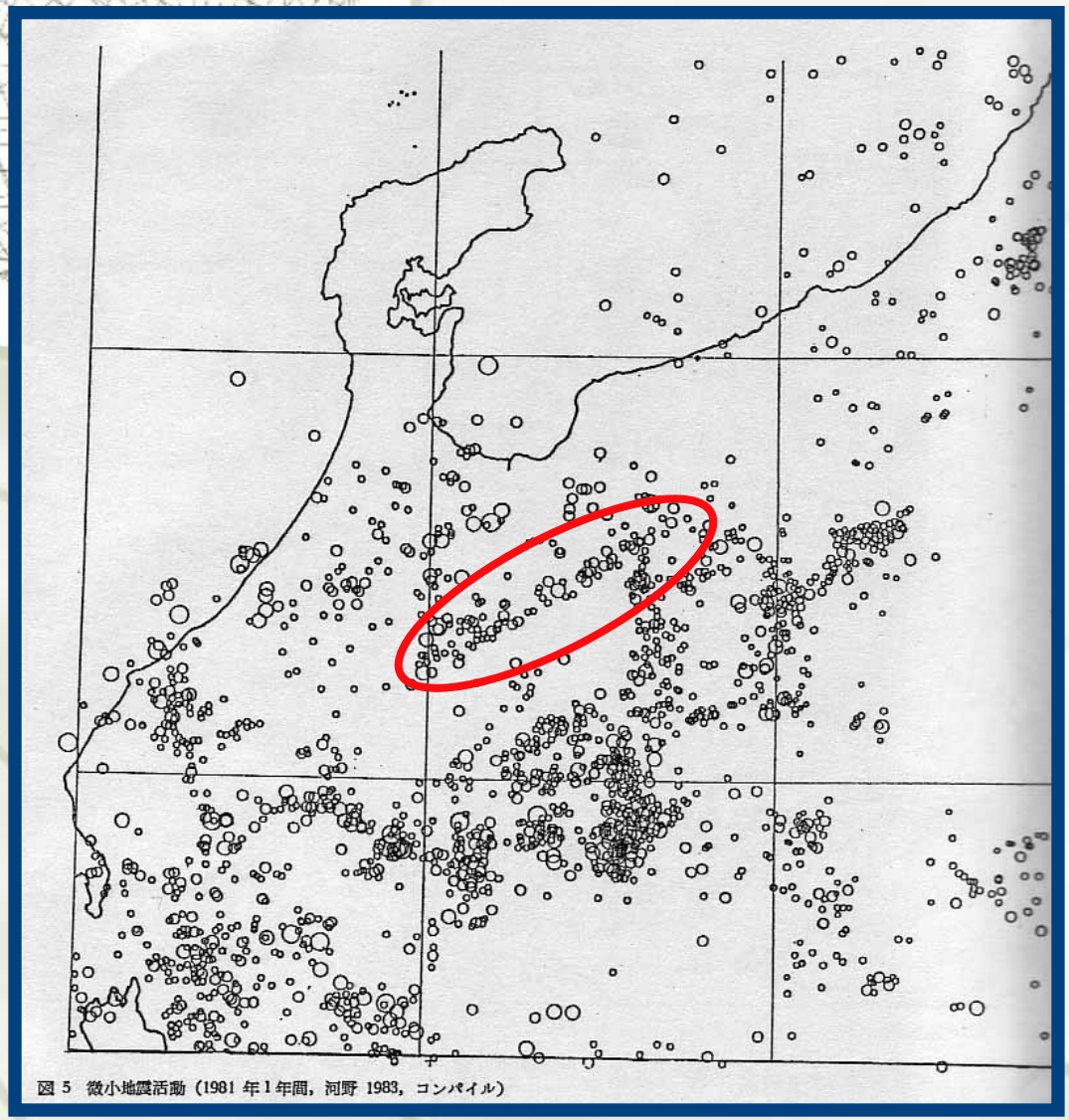


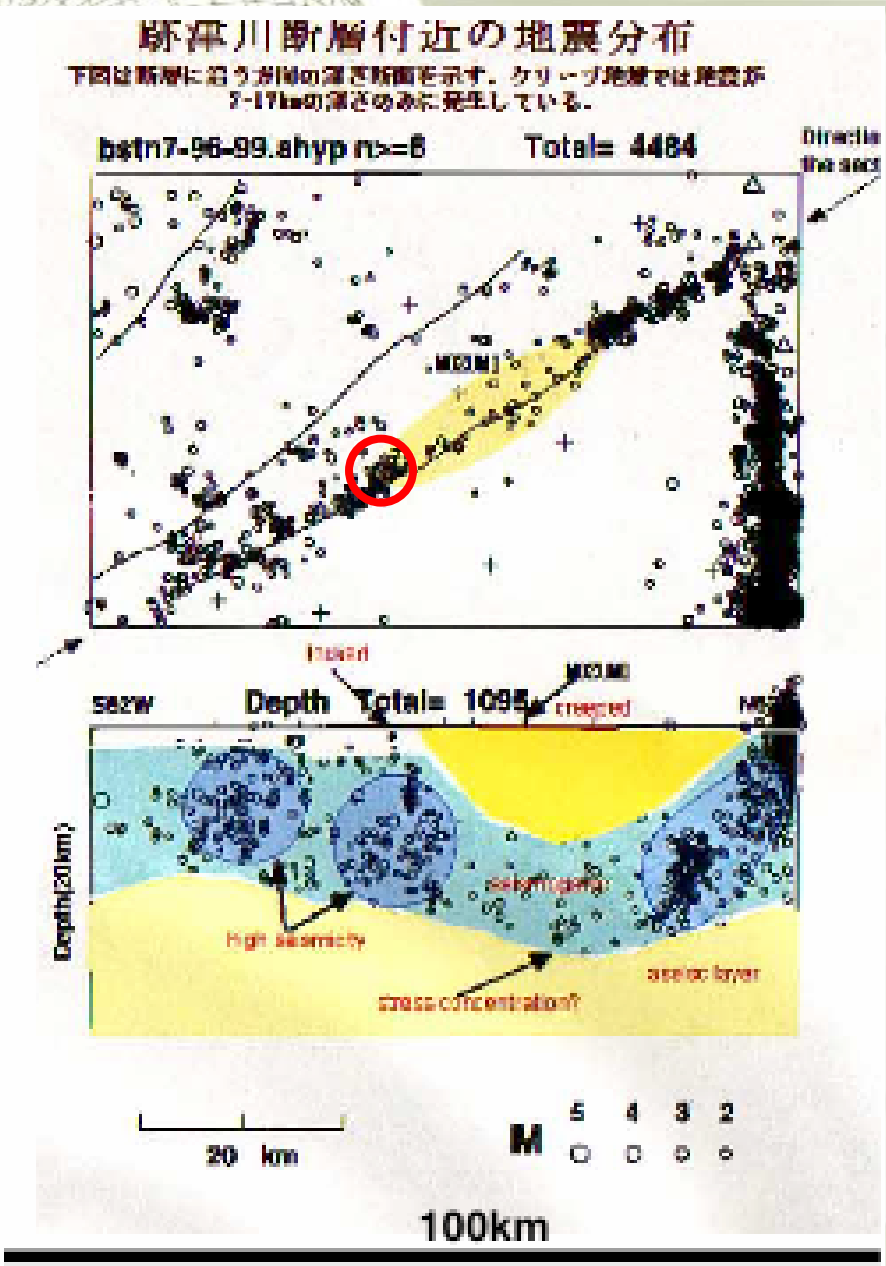
図 5　微小地震活動（1981 年 1 年間，河野 1983，コンパイル）

★Seismicity in one year at NW Japan.

★Dense seismic events around volcanoes.

★Linear arrangements of micro sismicity along the Atotsugawa fault.

★Evidence showing Atotsugawa fault is an active fault.



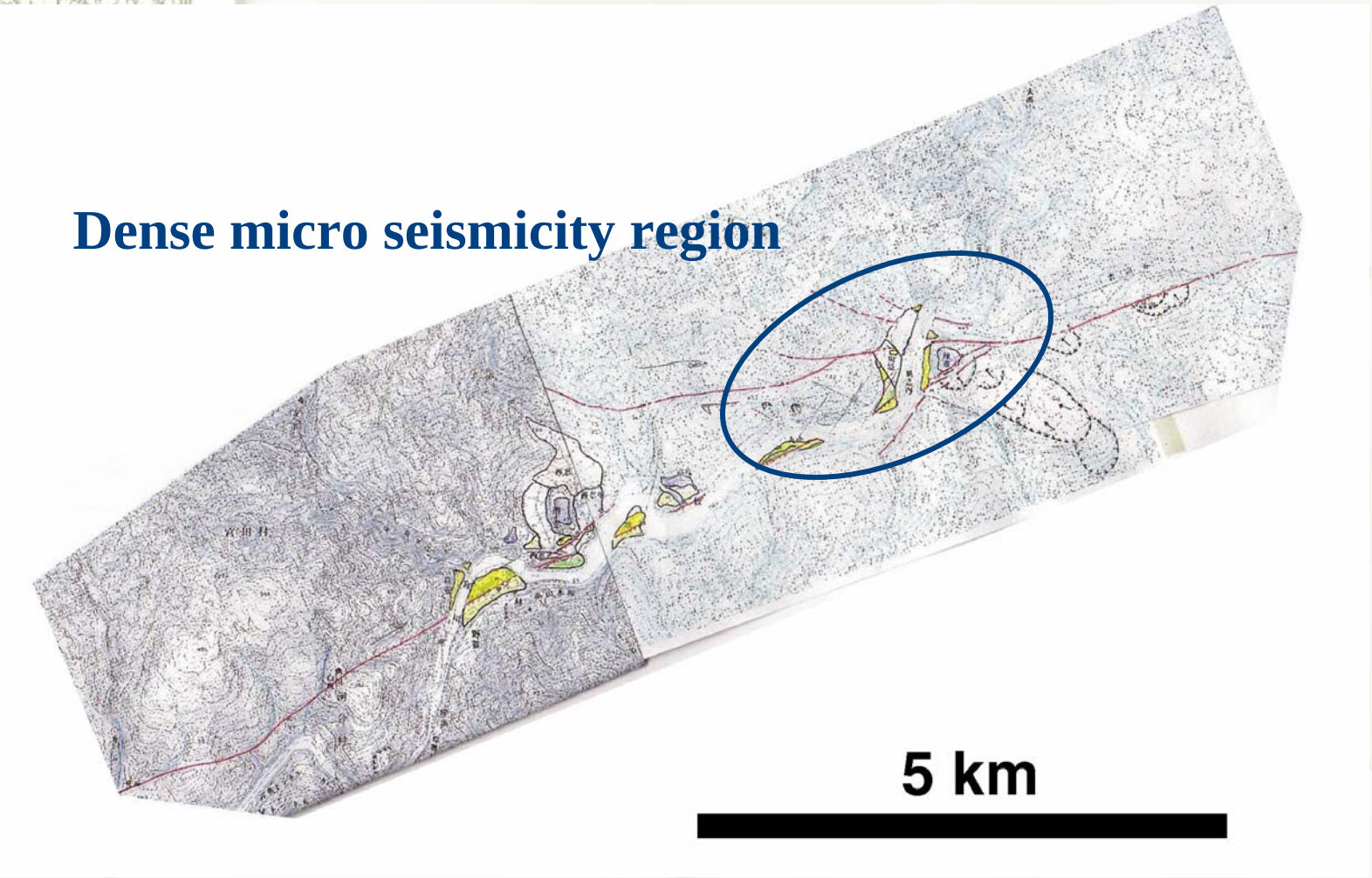
Characteristics of seismicity along the Atotsugawa Fault

(1) ENE - WSW trending right-lateral, active fault in NW Japan. Many micro-earthquakes along the fault

(2) Heterogeneous distribution along the fault.

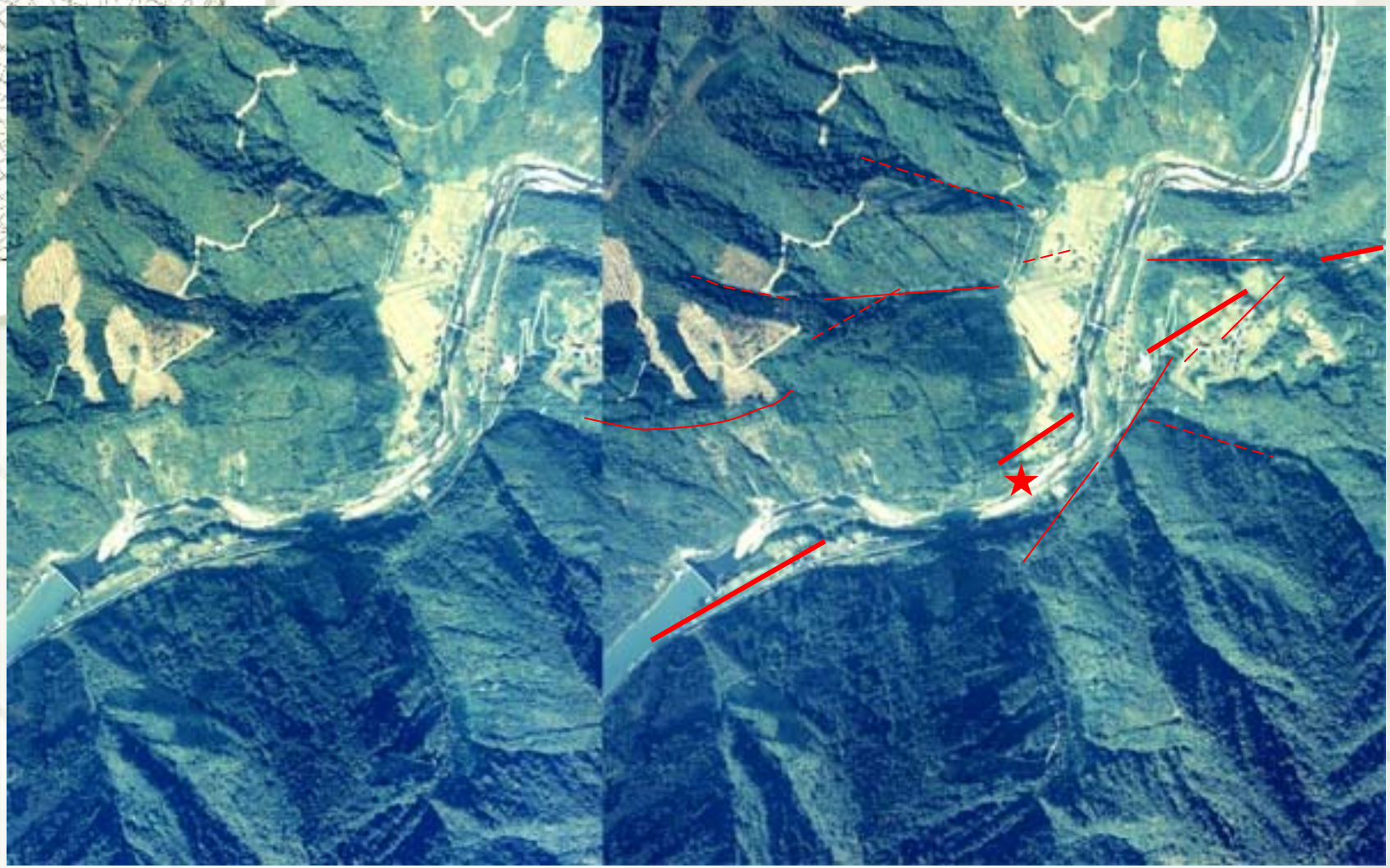
(3) Dense micro seismicity at both ends of less micro seismicity region, which are characterized by sallower (< 5 km) focal depth.

Characteristics of trace of the Atotsugawa Fault at the dense micro seismicity region



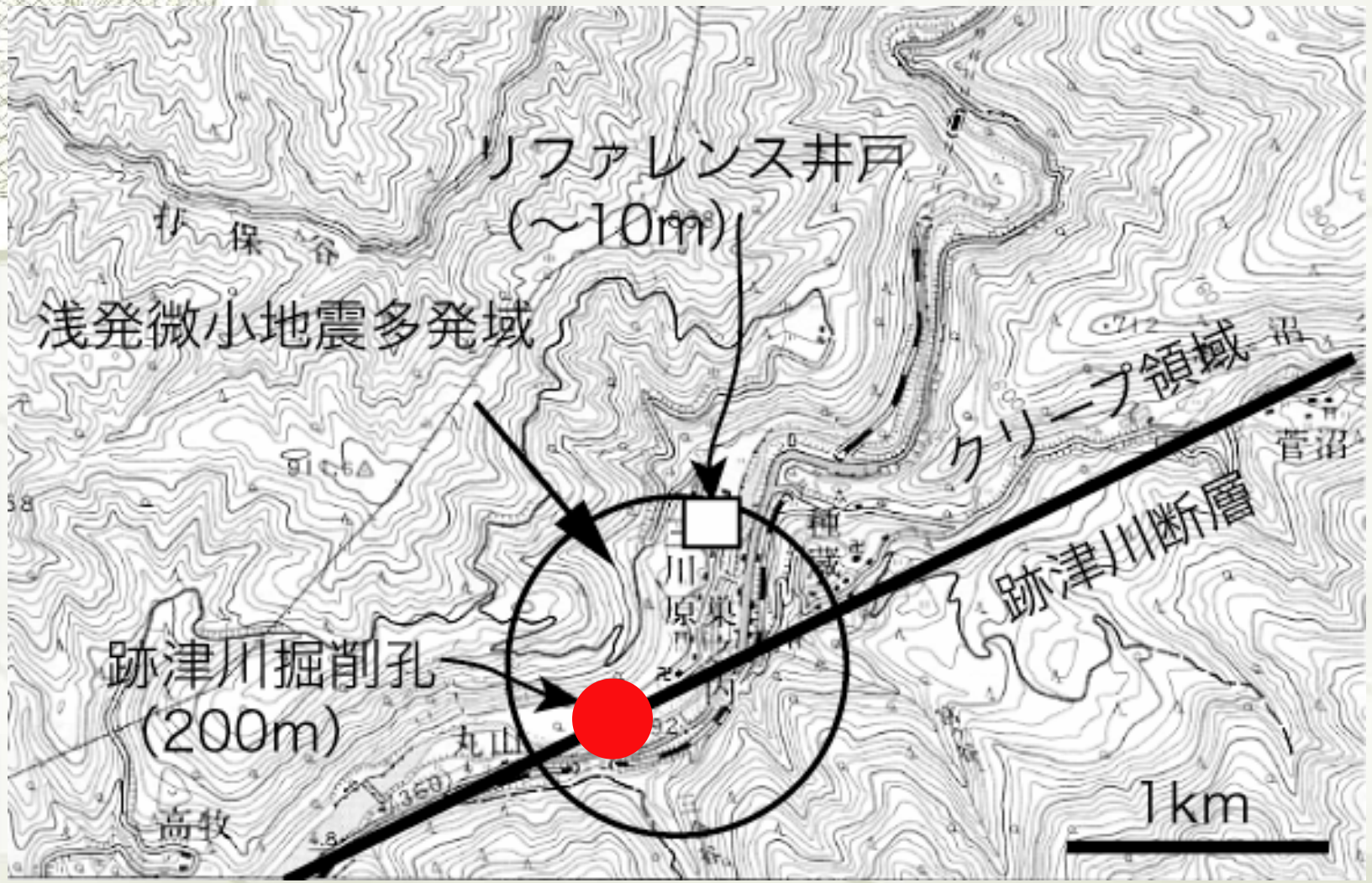
Complicated branching of the fault in this region → Barrier

Stereo projection of complicated fault trace

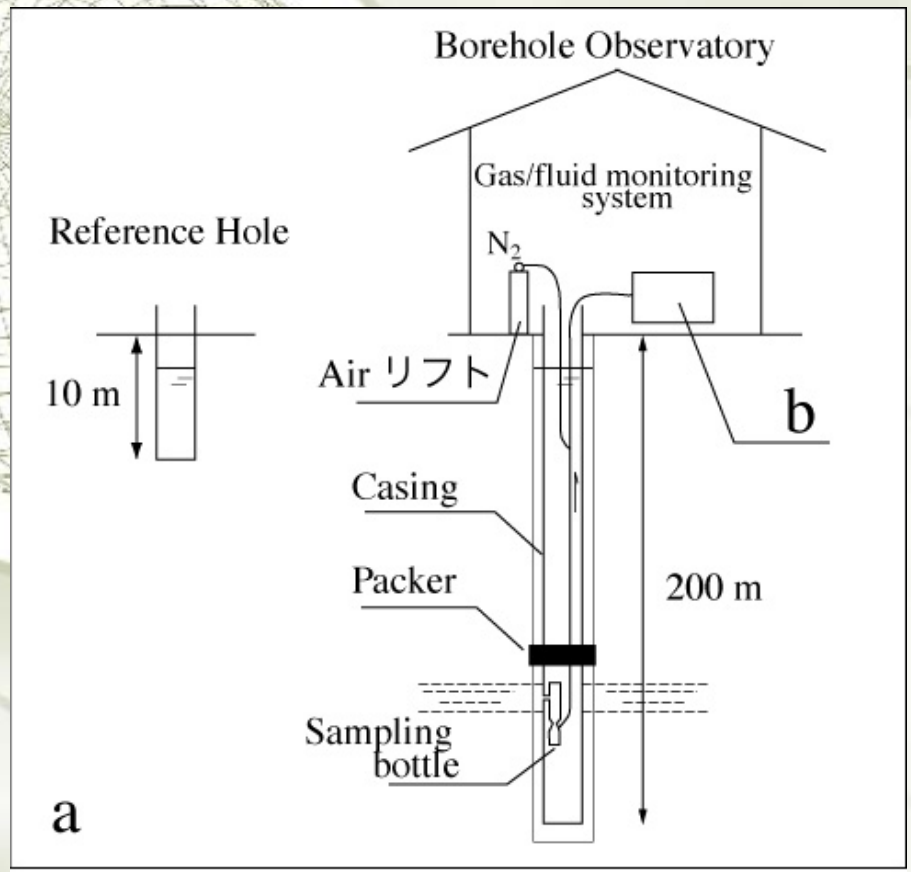


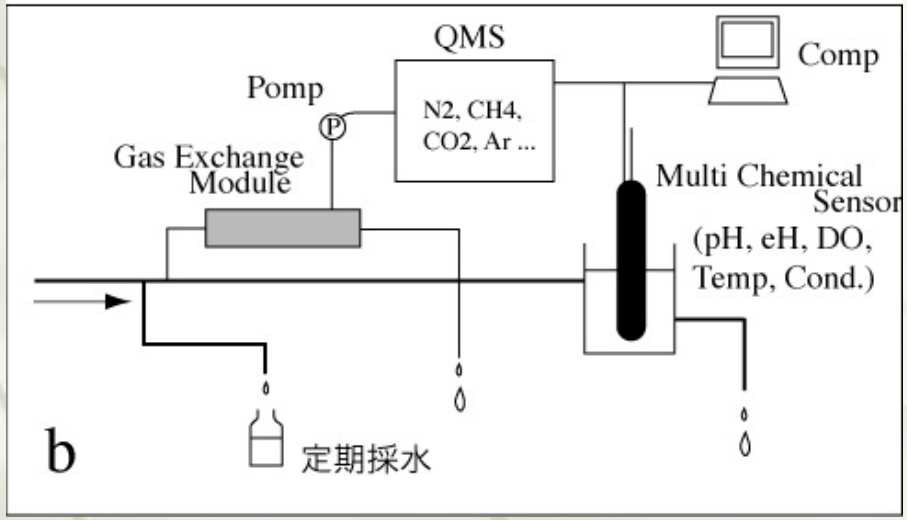
Distribution of lineaments（Red bold line；Atotsugawa faults）

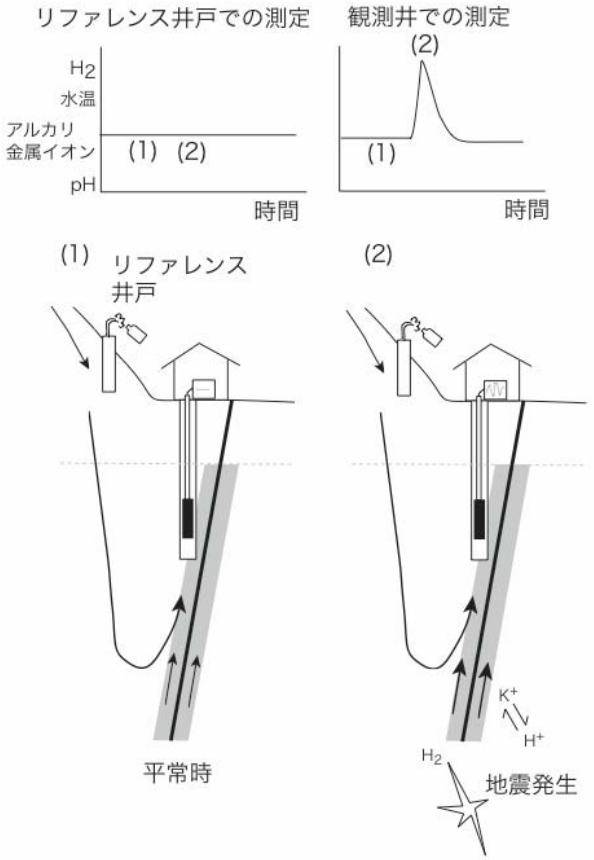
Borehole penetrating Atotsugawa Fault at dense micro-seismicity region (2002 - 2005)



Purpose of penetration of the Active fault

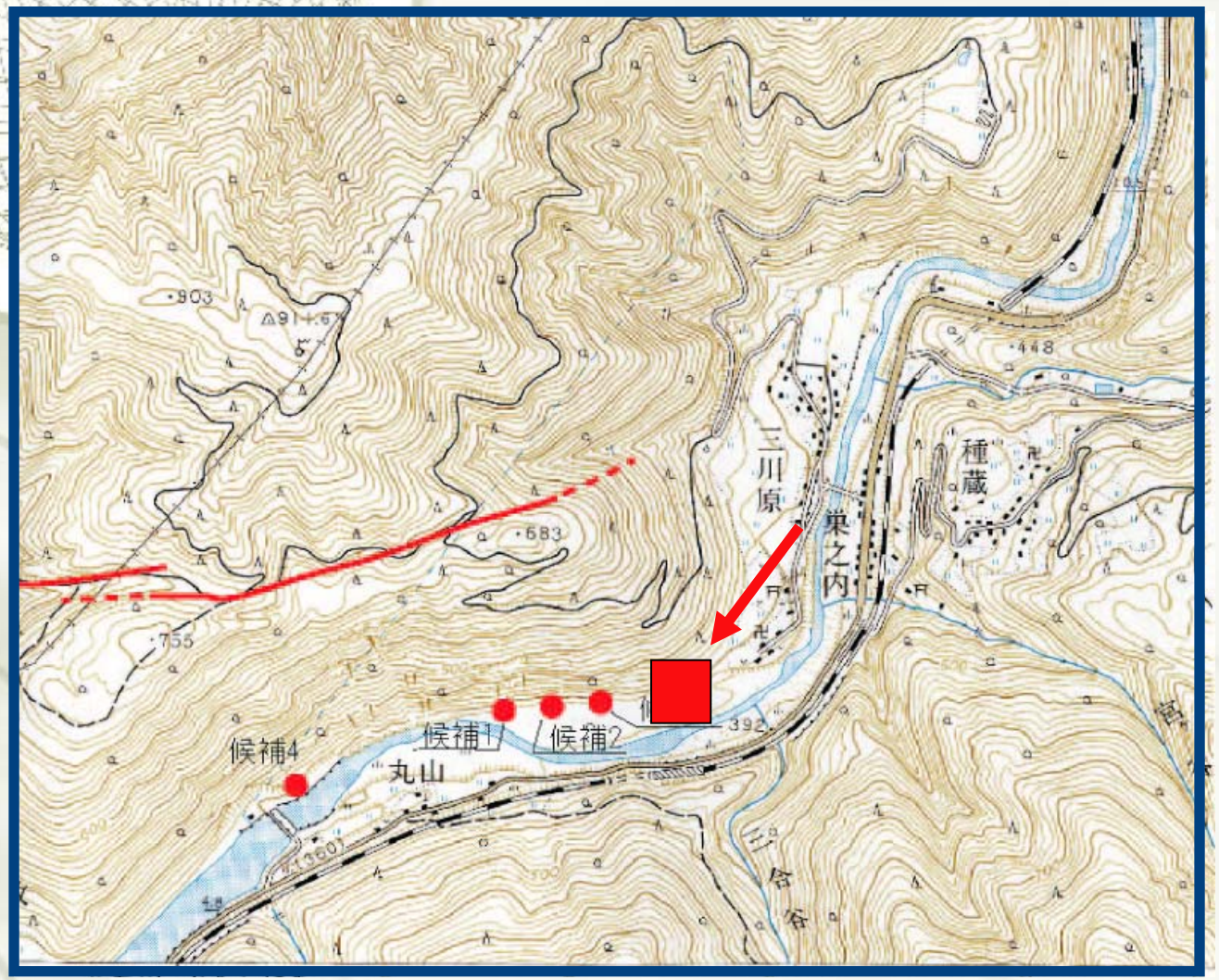






Monitoring of fluid path
Chemical Reaction by seismic slip

Candidates of borehole sites



Several candidates for borehole sites

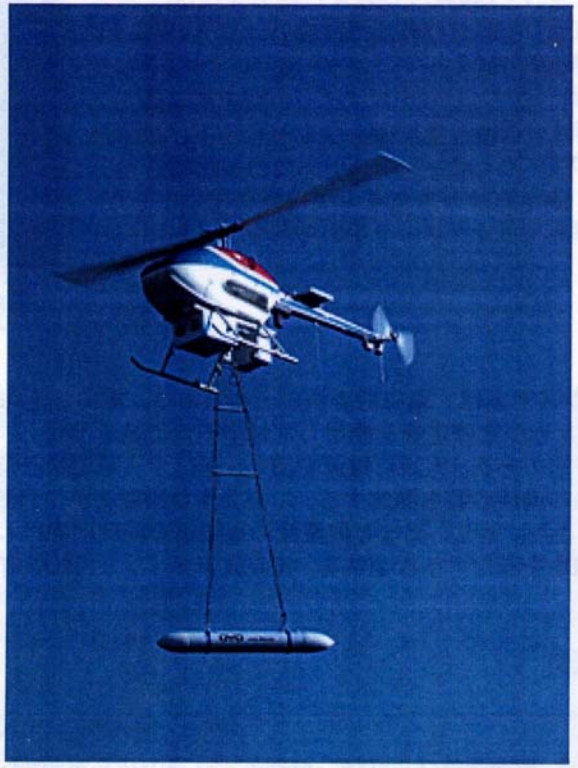
↓

More precise data for fault trace were required.

↓

But How?

OYO mini-Borne System



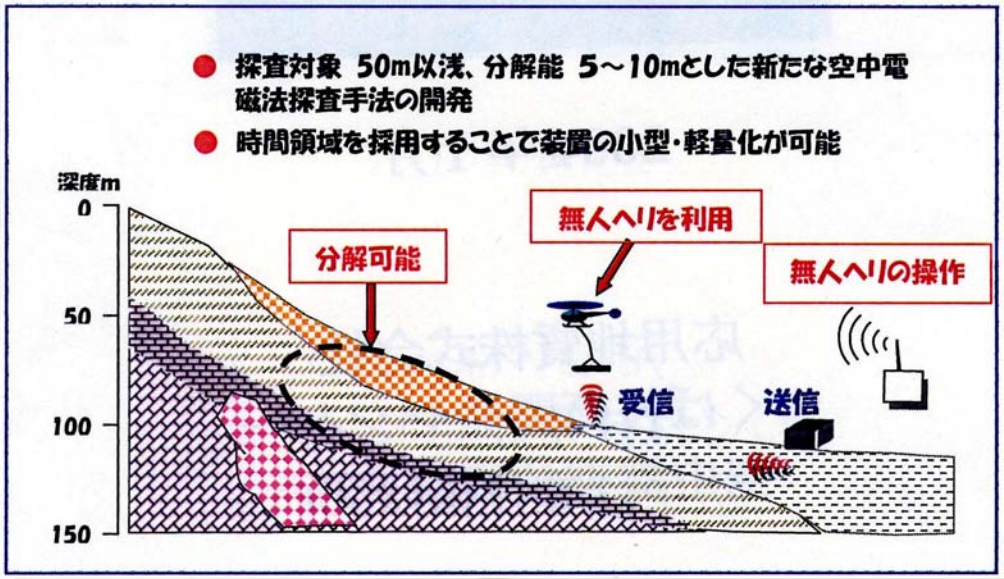
2004 年 1 月

応用地質株式会社
つくば技術開発センター
空中探査技術研究所

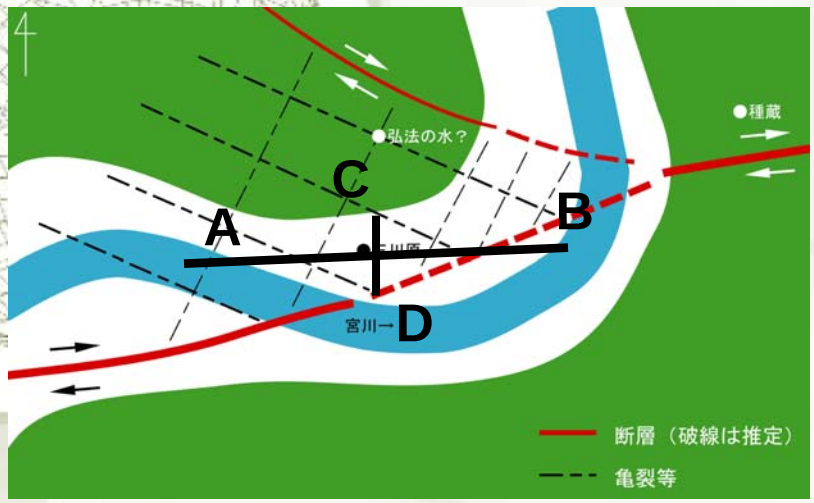
Air-borne Electromagnetic exploration

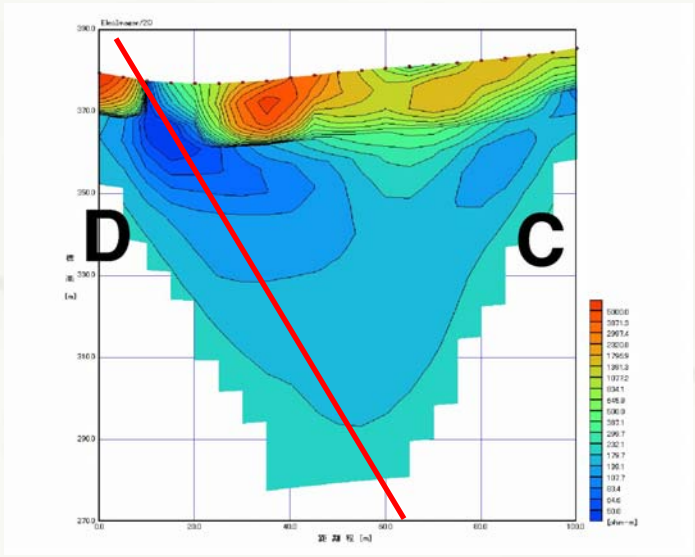
Determination of the best point for penetration to the fault zone

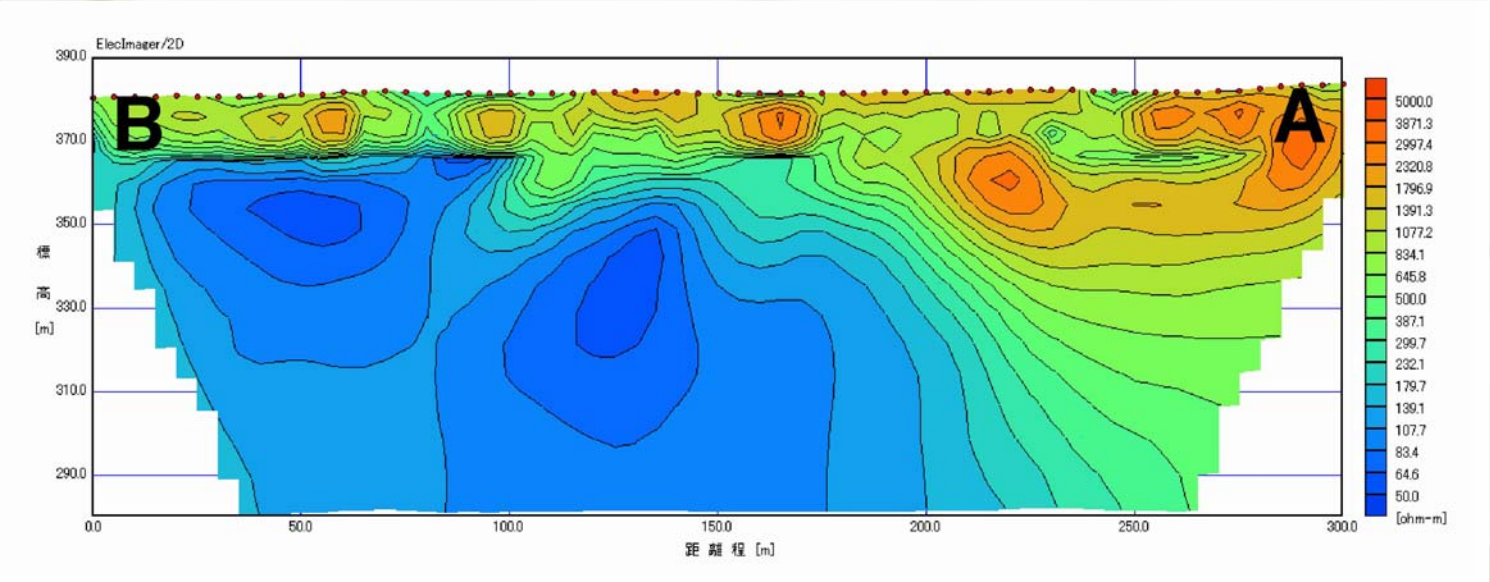
Abundant fluid in fault zone
↓
Lower resistivity in fault zone
Higher resistivity in host rock



Results of Electromagnetic exploration



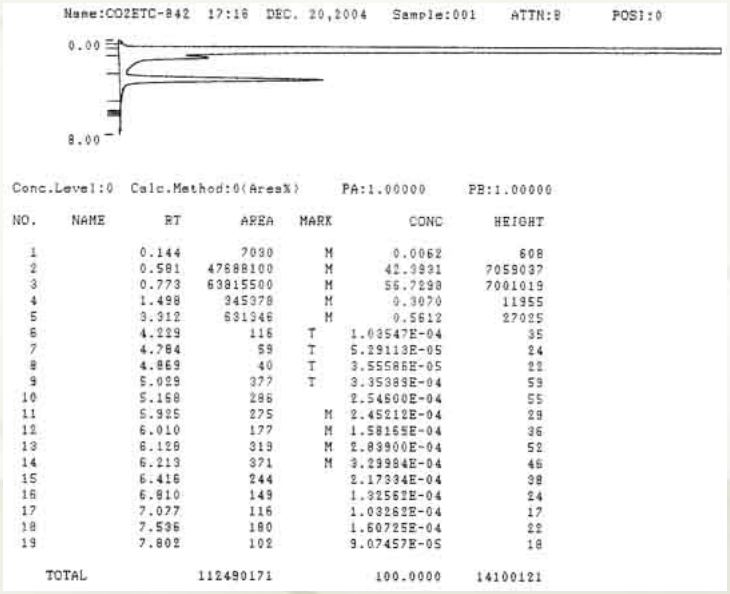




Exact fault trace was confirmed!!

Drilling Rig

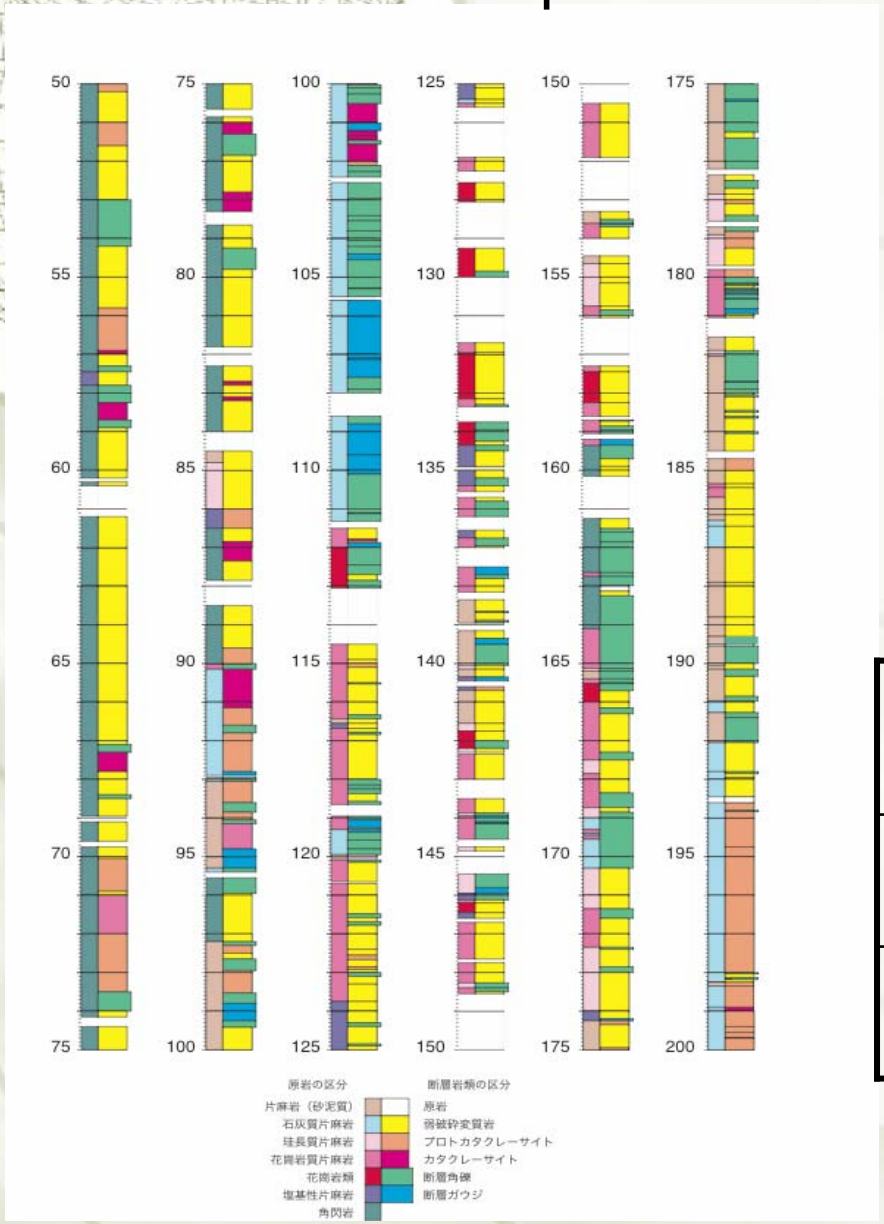
Gas Sampling from drill-core and gas composition analysis



Conc.Level:0 Calc.Method:0(Area%) PA:1.00000 PB:1.00000

NO.	NAME	RT	AREA	MARK	CONC	HEIGHT
1		0.144	7030	M	0.0062	608
2		0.581	47888100	M	42.3891	7059037
3		0.773	63815500	M	56.7298	7001019
4		1.498	345378	M	0.3070	11955
5		3.312	631346	M	0.5612	27025
6		4.229	116	T	1.03547E-04	35
7		4.784	59	T	5.29113E-05	24
8		4.869	40	T	3.55585E-05	22
9		5.029	377	T	3.35389E-04	53
10		5.158	286		2.54600E-04	55
11		5.925	275	M	2.45212E-04	29
12		6.010	177	M	1.58165E-04	36
13		6.126	319	M	2.83900E-04	52
14		6.213	371	M	3.29984E-04	46
15		6.416	244		2.17334E-04	38
16		6.810	149		1.32562E-04	24
17		7.077	116		1.03282E-04	17
18		7.536	180		1.60725E-04	22
19		7.802	102		9.07457E-05	18
TOTAL			112490171		100.0000	14100121

Precise but complicated



Profile analysis of the Atotsugawa Fault zone

Classification of fault rocks from 50 m to 200 m depth

1) consolidated ／un-consolidated
2) contents of fragment
< 30 % or > 30%

	Consolidated	Un-consolidated
Fragment > 30%	Cataclasite	Fault breccia
Fragment < 30%	Proto cataclasite	Fault gouge

Simplification of fault zone architecture

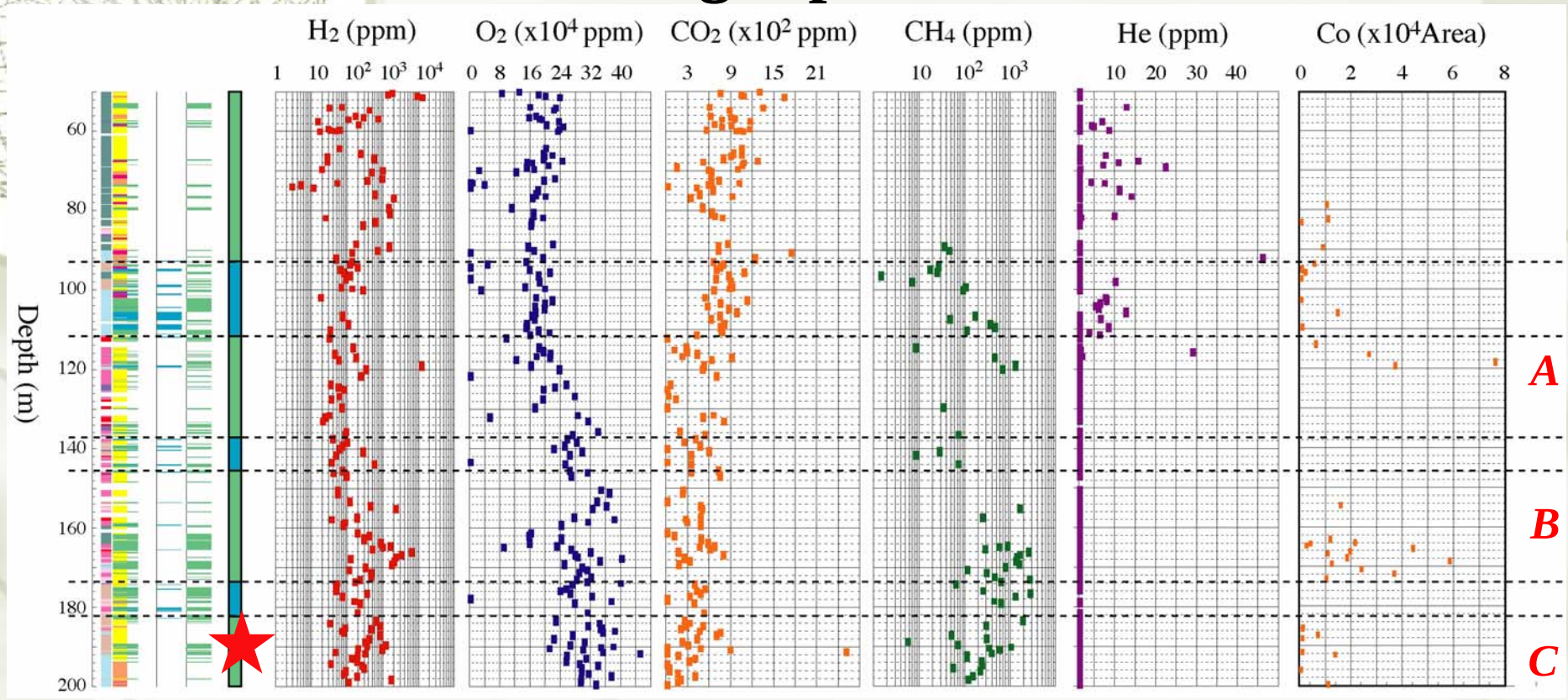
Determination of fault core

(1) Dense development of fault gouge zone (> 1 layer / 2m) is regarded as minor fault core.

(2) Neighboring minor fault cores are within 4 m, they are regarded as single major fault core.

(3) The zones between the major fault cores are damage zone.

Comparison between Fault zone architecture and gas profile



	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	HCO3	δD
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	‰
弘法清水	2.1	0.0	1.0	1.4	42.1	2.1	3.1	4.7	129.9	−73
宮川	3.3	0.0	1.5	1.0	15.2	2.3	0.3	3.9	53.2	−69
観測井戸	333.1	0.0	4.5	4.2	14.9	199.2	0.0	3.5	610.8	−79

Development of Fluid Monitoring System
（2004 - 2006　1st and 2nd generation）

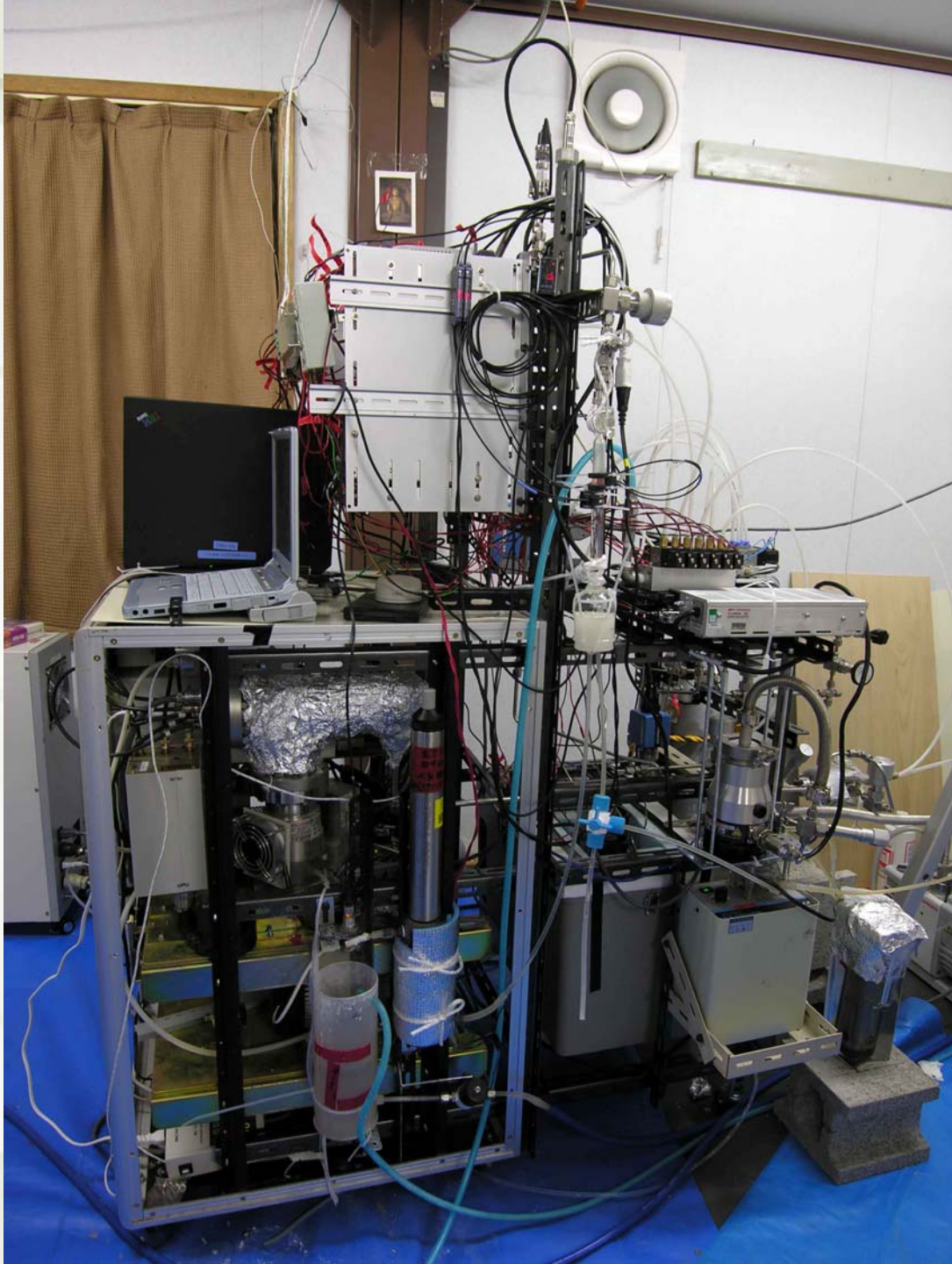
Development of Fluid Monitoring System （2007 - 2009　3rd generation）

★Smaller the system than 2nd generation machine (but ugly…)

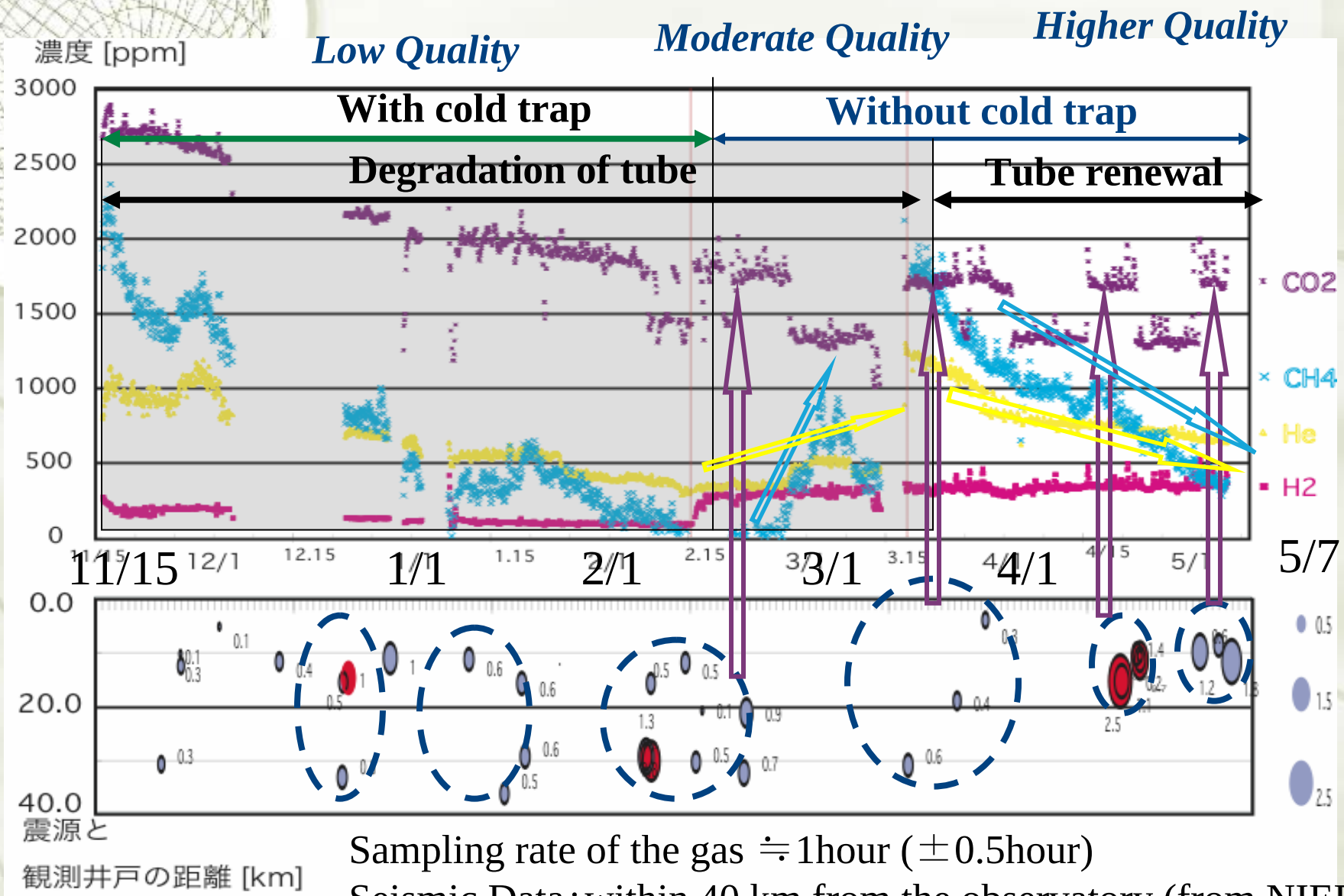
★More stable and precise measurement

★Reduction of noise and error

Pat.No. 2006-001295



An example of unstable data acquisition from 1st to 3rd generations of our QMS



Sampling rate of the gas ≒1hour (±0.5hour)

Seismic Data：within 40 km from the observatory (from NIED)

4_{th} generation Fluid monitoring system

Ground Water Data Analyzing System

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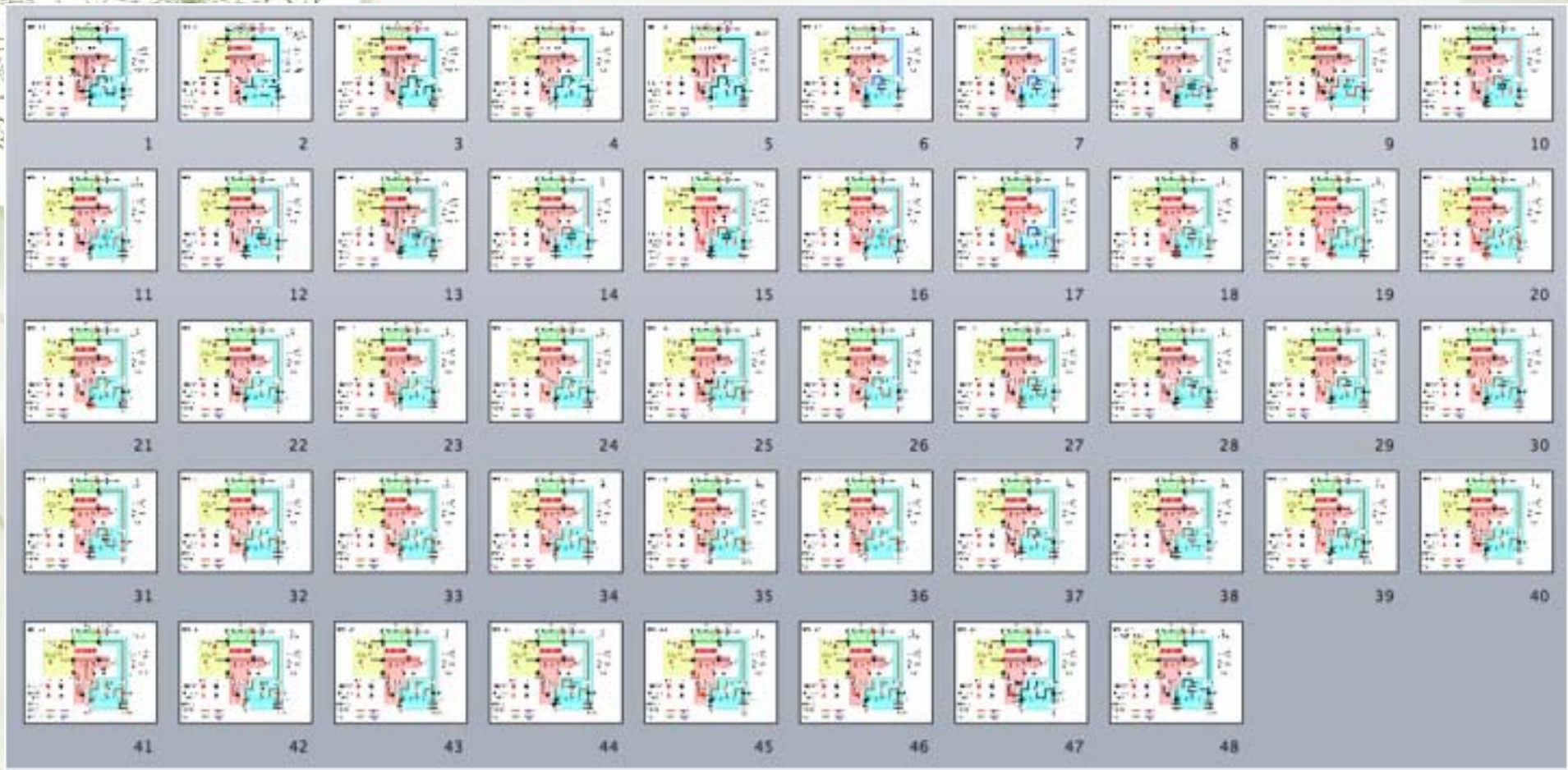
Full-automatic gas purification procedure is implemented!!



48 steps sequence for gas purification

GROWDAS
Presentation

ガス連続観測の新時代へ
全自動ガス連続分析機器

東京大学
THE UNIVERSITY OF TOKYO

GROWDAS

特許取得済

主な測定対象

・地下水に含まれるガスの濃度
・都市排気に含まれる
温暖化ガス成分
etc...
(水蒸気除去機構　搭載)

リアルタイムで
データを随時送信！

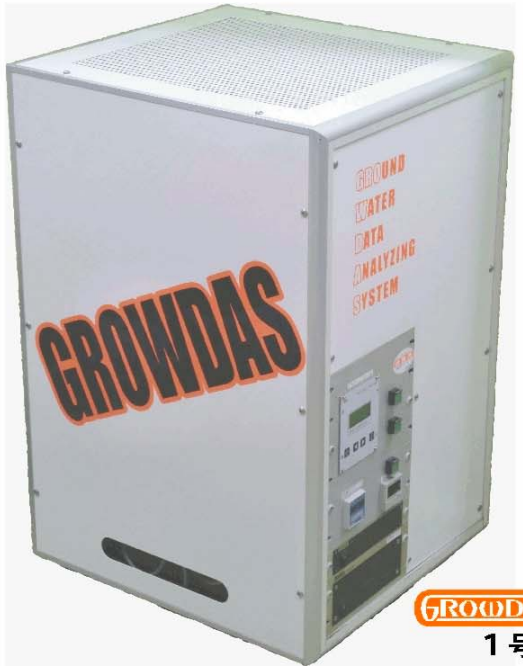
インターネットを通じて
リアルタイムで制御,
測定条件変更にも柔軟に対応！

全自動で観測！

気液分離
水蒸気除去
ガス濃度測定
水質計測
すべて全自動！

目的に応じて
カスタマイズ自在！

観測・計測目的に応じて
ハイエンドからローエンドまで
カスタマイズ可能！



1号機