A site-specific ILC-CFS design and the Green ILC
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Владивосток
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北朝鮮
평양
北京
河北
日本
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甘肃
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自治区
山西
名古屋
大阪
広島
陕西
山东
黄海
中華人民
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Macau
Hong Kong
フィリピン海
ラオス
Google
海南

“Kitakami highland” is the unique ILC candidate site since summer in 2013: Characteristics are summarized below;

- Geology → Large and uniform granite area without fault
  - Low risk for underground construction
  - Very small ground motion/vibration
- Topography → rolling hills
  - Easy to access from ground surface to the main tunnel
  - Tunnel elevation is 110m high → ground water drainage can be due to gravity (no risk of flood)
- Important social infrastructures
  - Electricity
  - Industry water
  - Transportation & mobility
- Small impact on the natural environment
  - Preliminary studies were carried out for two years

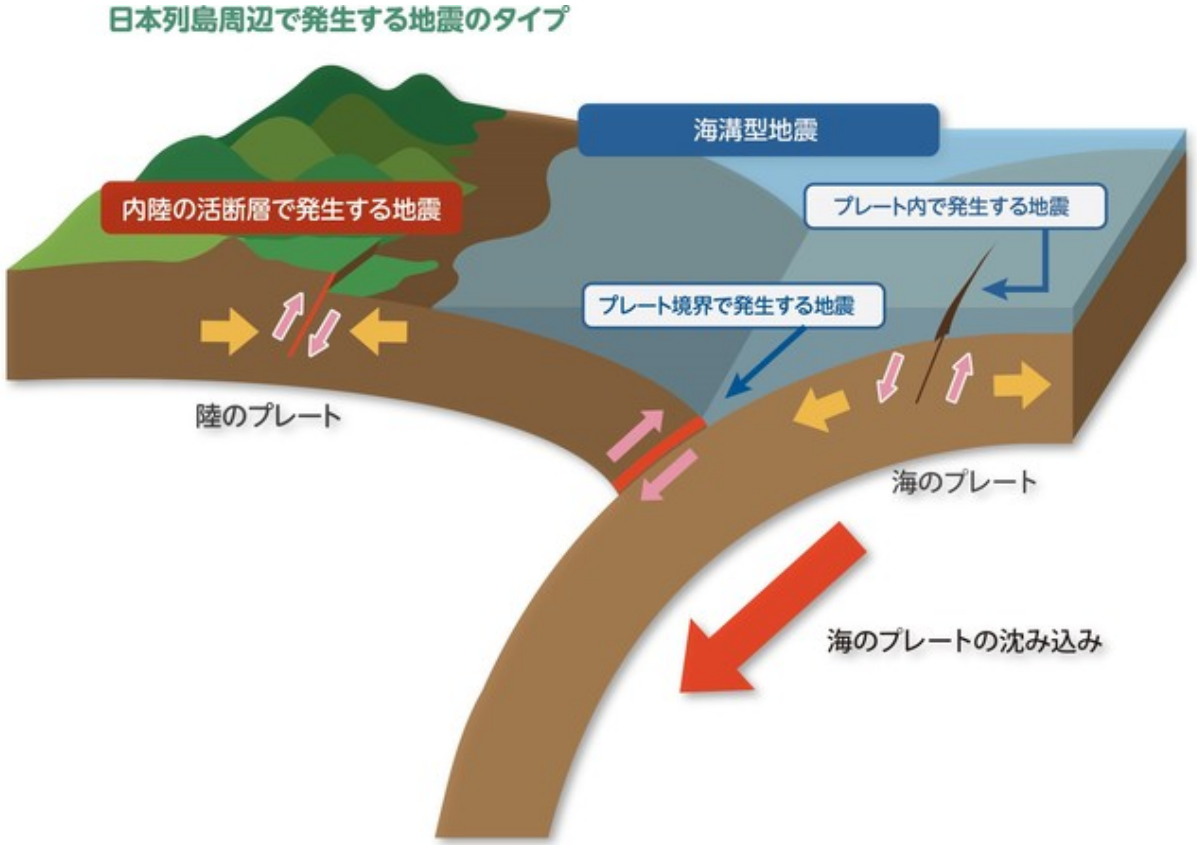
Basic knowledge about earthquake

① Active fault type

② Plate type (Subduction-zone earthquake)

③ Earthquake ground motion in ILC tunnel

deep underground ~ 20% of the ground surface



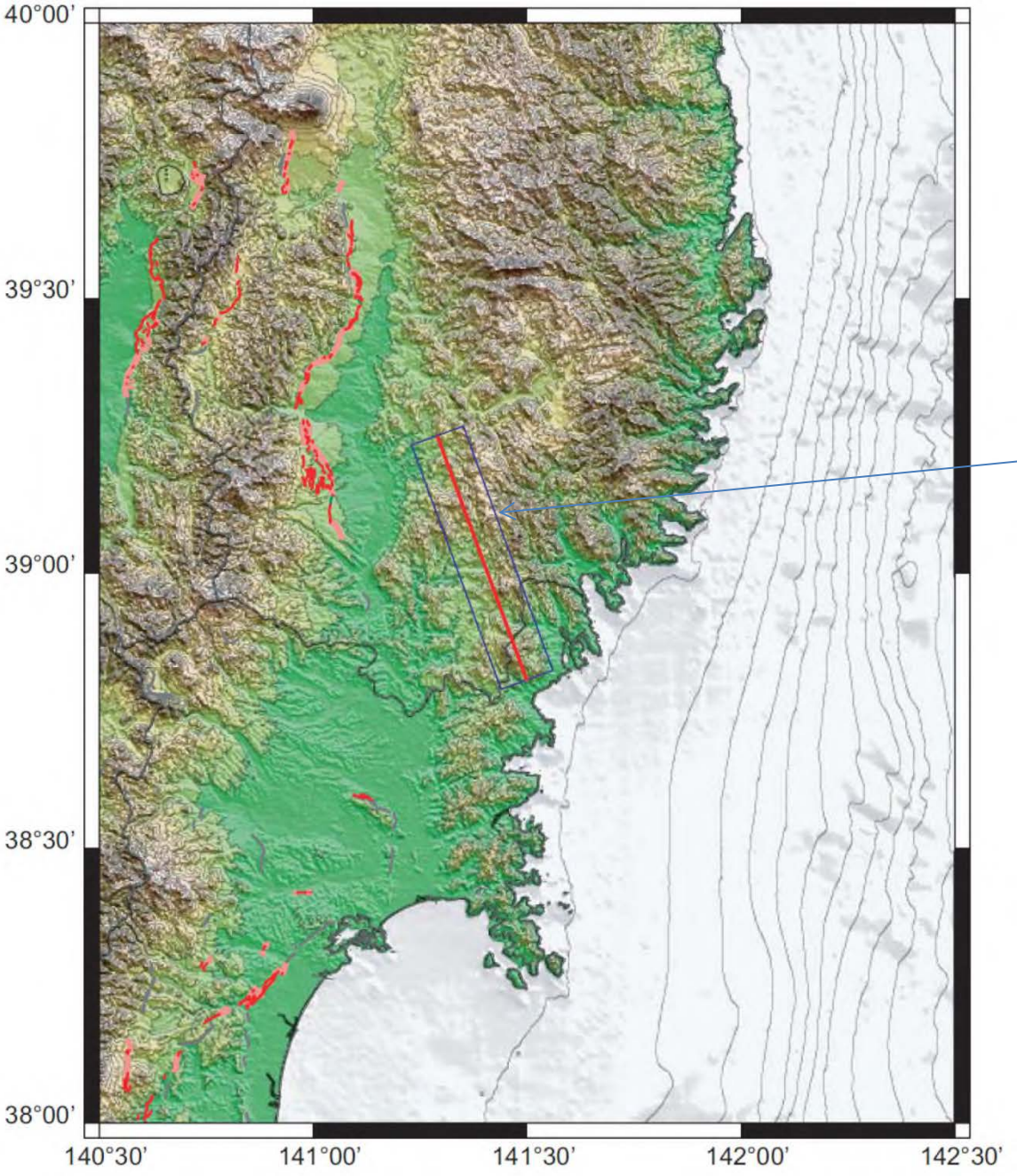
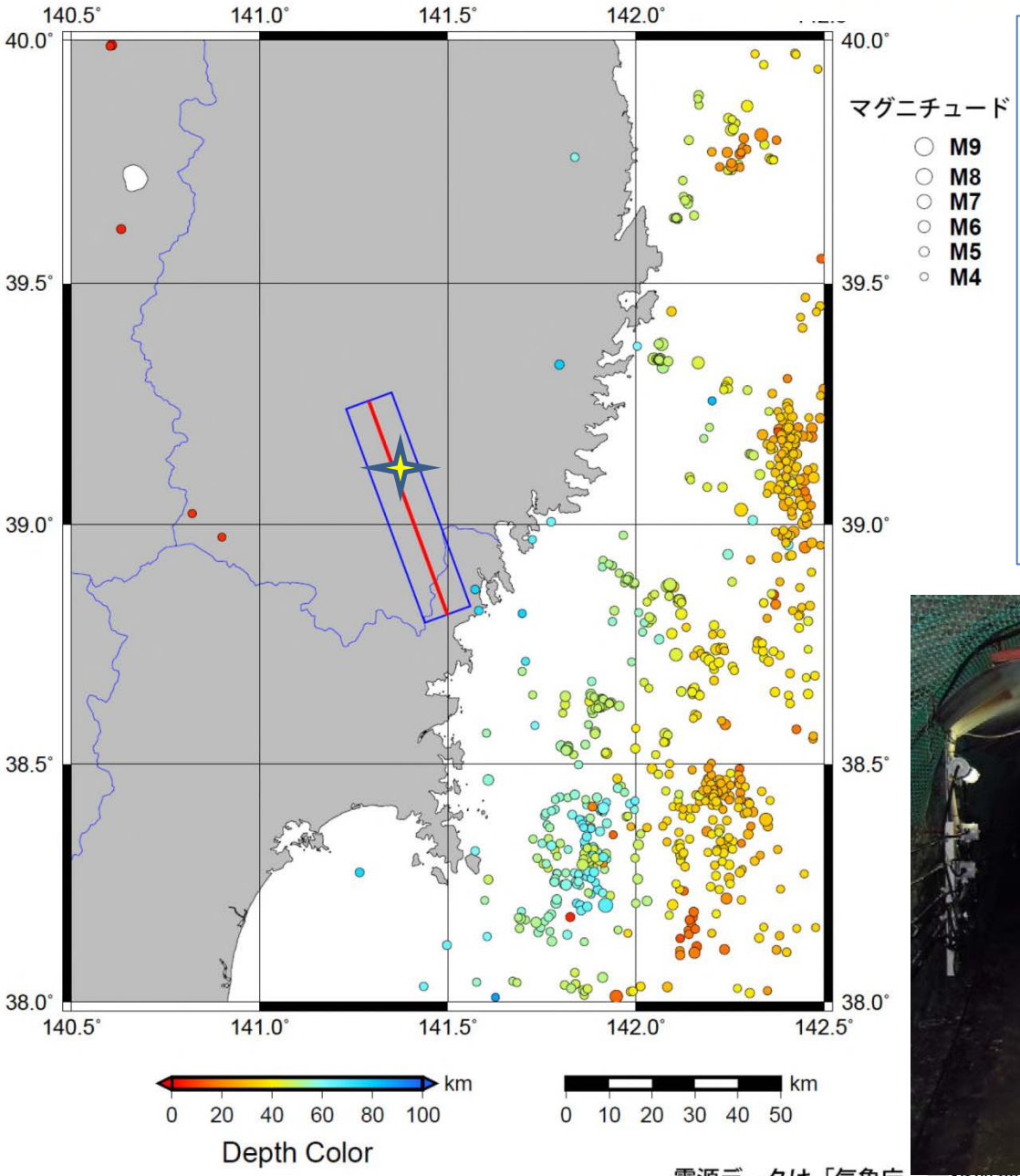


図 2.3　地形と活断層分布図

Kitakami site is free from the fault type earthquake

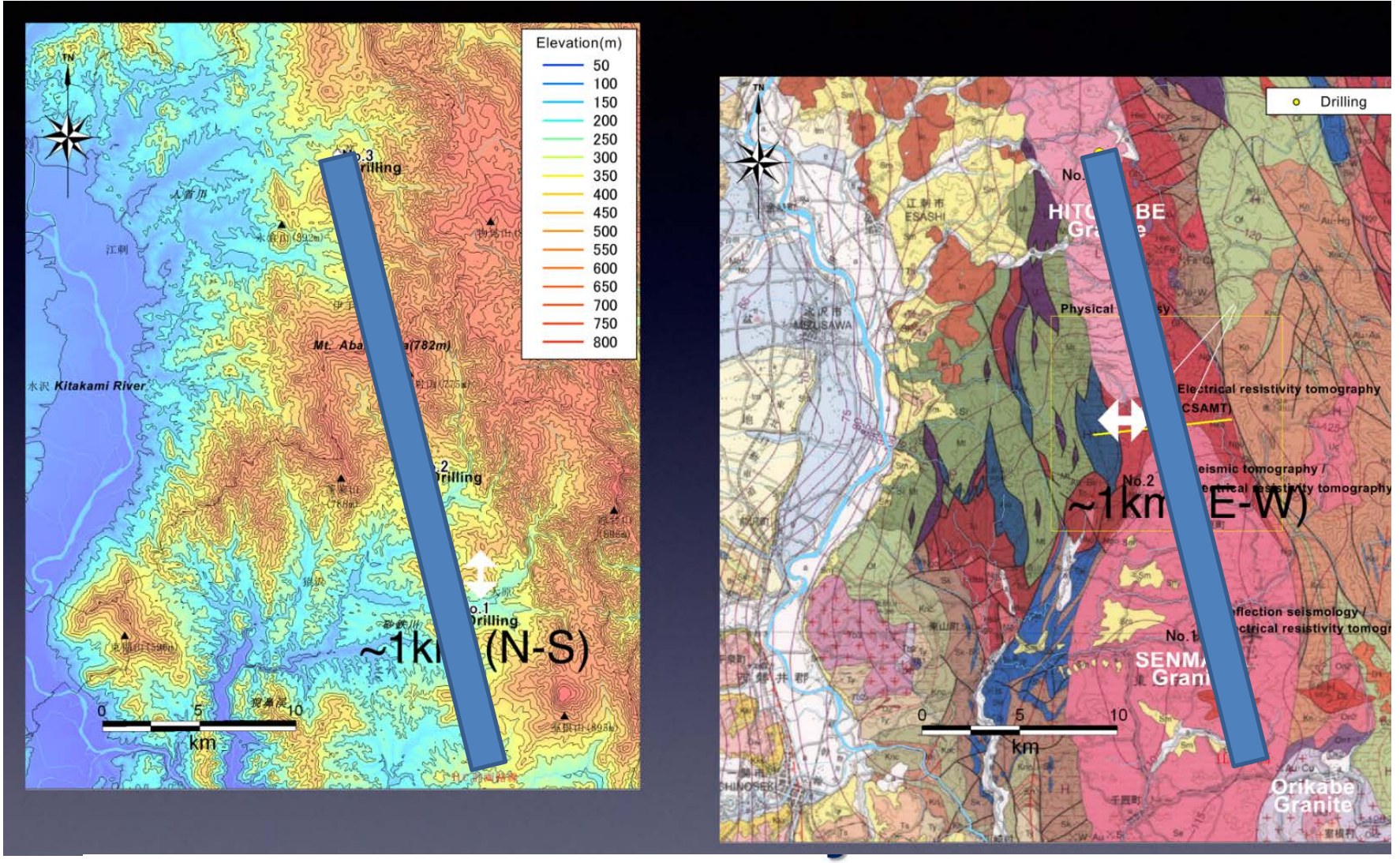


Coincidentally, “Esashi earth tide observatory underground facility” locates in the same granite zone as ILC. All fragile equipment and long glass tubes are not damaged at all.

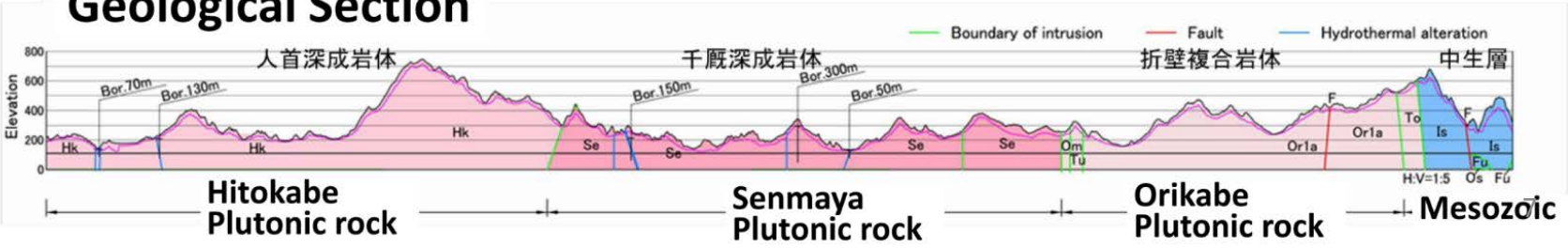
① Earthquake ground motion in the granite zone is coherent .

② Earthquake ground motion in the deep underground is ~20% of the ground surface.

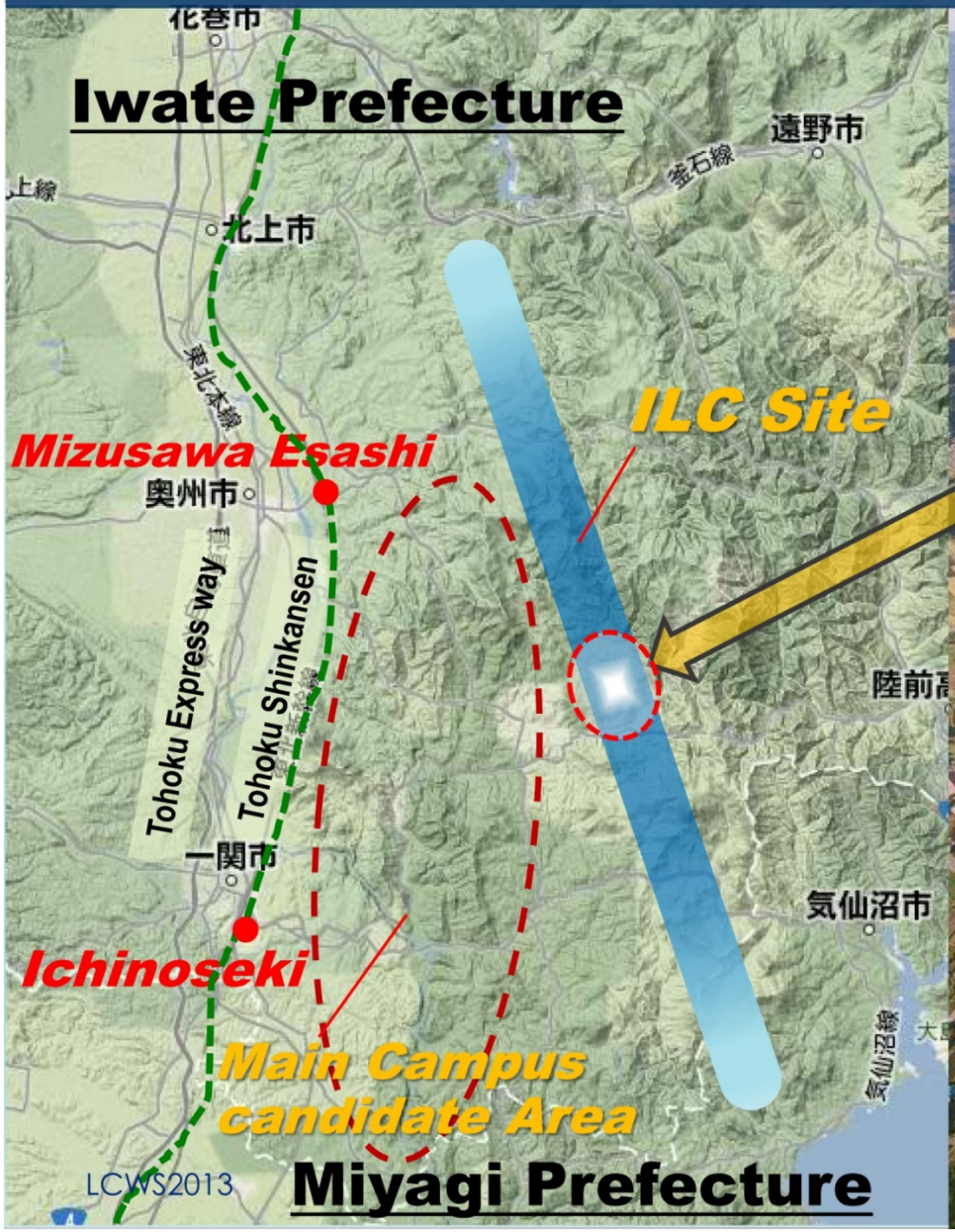
震源データは「気象庁一元化処理」



Geological Section



Location


Iwate Prefecture
花巻市
遠野市
釜石線
北上市
東北本線
Mizusawa Esashi
奥州市
ILC Site
Tohoku Express way
Tohoku Shinkansen
一関市
陸前高
気仙沼市
Ichinoseki
Main Campus
candidate Area
気仙沼線
Miyagi Prefecture


Central region
Satetu-gawa River

List of necessary survey and study items, which Tohoku team has carried out so far.

◆ 地表探査 Survey from ground surface
- 断層調査 Fault survey
- 地表地質調査 Ground surface geological survey
- 放射能探査 Radioactivity survey
- 屈折法地震探査 Seismic refraction
- 反射法地震探査 Seismic reflection
- 電磁探査（CSAMT法） Electromagnetic survey
- 重力探査 Gravity Survey

◆ 穿孔探査　Boring survey
- 試験片調査　Sample survey
- 穿孔孔電気検層　Boreholes Electrical logging
- 同・速度検層　Boreholes velocity logging
- 湧水圧試験（JFT法）Ground water pressure test
- 岩石試験 Laboratory test of rock samples
- 穿孔内面撮影/内壁面構造調査 Borehole inner face test
- 屈折法地震探査（垂直） Seismic refraction (Vertical test)
- 孔内水平載荷試験 Borehole lateral loading test

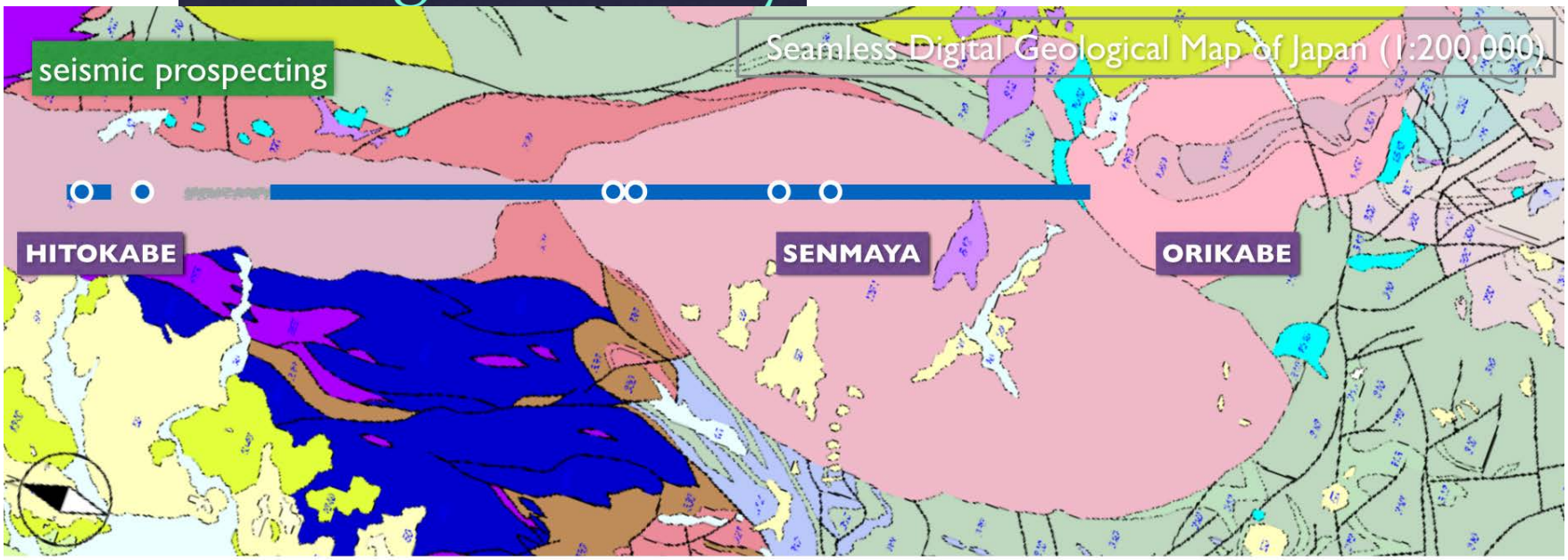
◆ 地盤振動調査 Ground vibration survey
- 地表 Surface: GPS network 1250 stations in Japan
- 地下 (KIK-net, national earthquake measuring network, by National Research Institute for Earth Science and Disaster Resilience) 100m deep underground stations (700 stations in Japan)

◆ 広域変動調査 Wide ground variation survey
- 三角点測量 Triangulation point measurement (974 1st level point, and many 2nd ~4th level points are maintained in Japan)
- GPS network

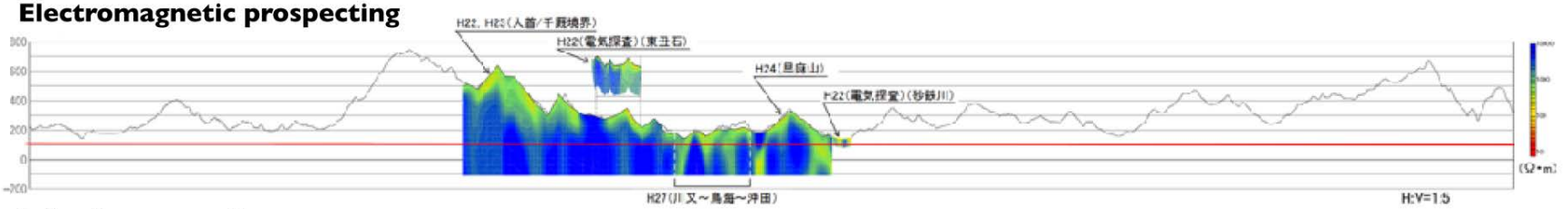
◆ 水文調査　Hydrological survey

Geological survey

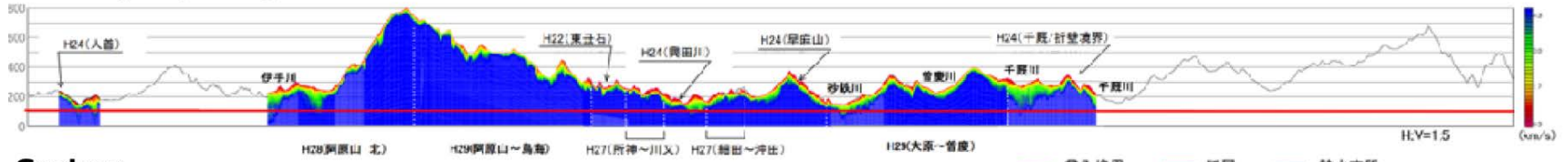
Slide by Tomo Sanuki (Tohoku Univ.)



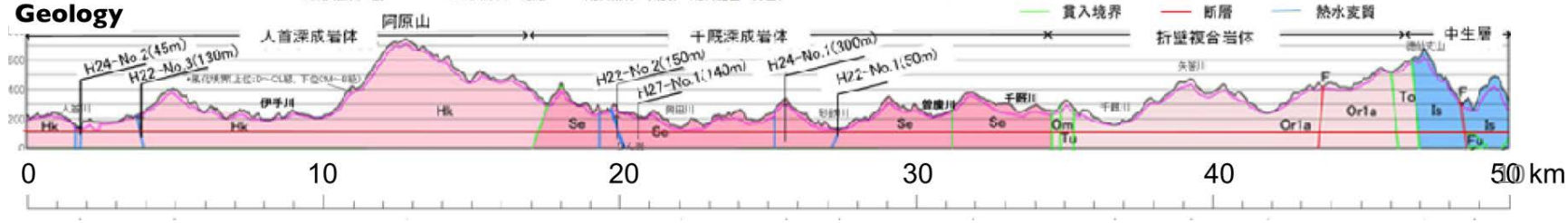
Electromagnetic prospecting



Seismic prospecting



Geology

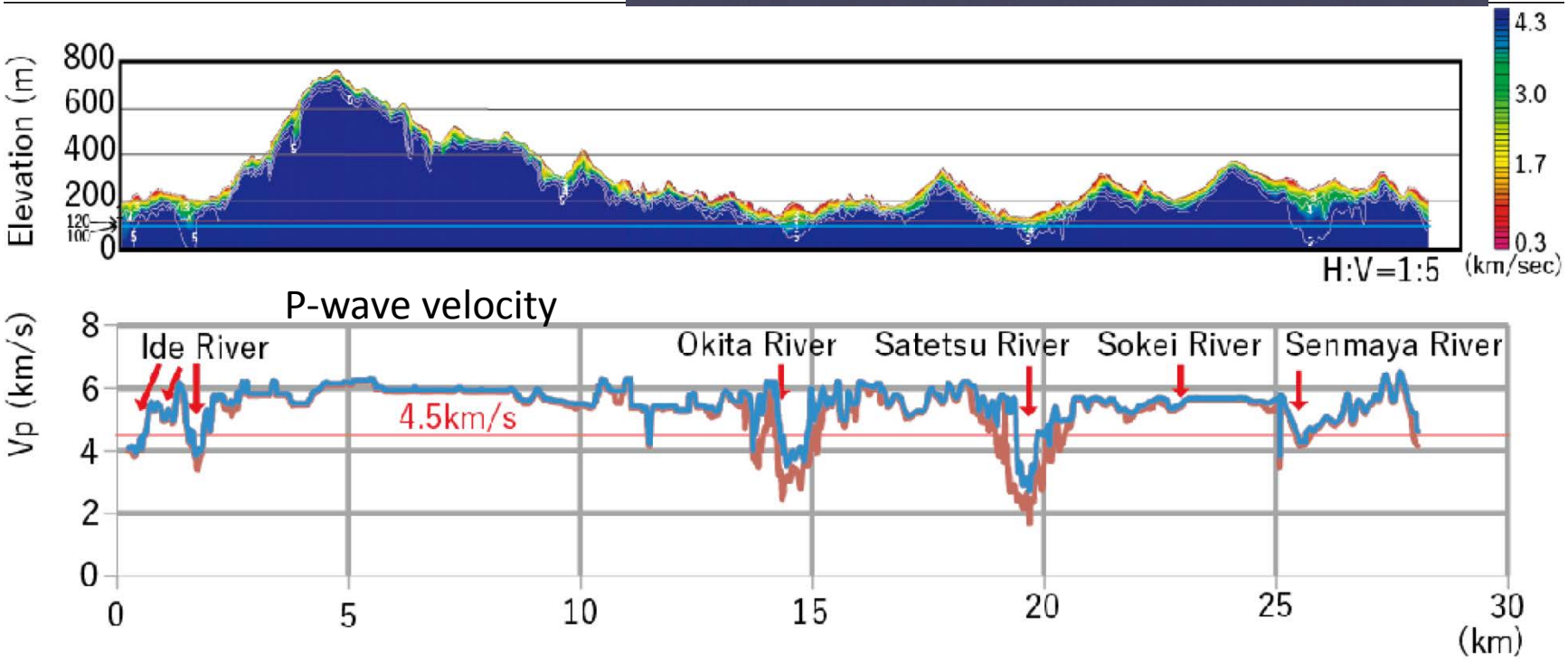


Geological survey

Slide by Tomo Sanuki (Tohoku Univ.)

- Covered the whole ILC250 line
- Got the whole picture of the geology
  - Nice, for the most part
  - Requires attention, only a part of the line

Seismic prospecting
Blue: very good



Geological histogram

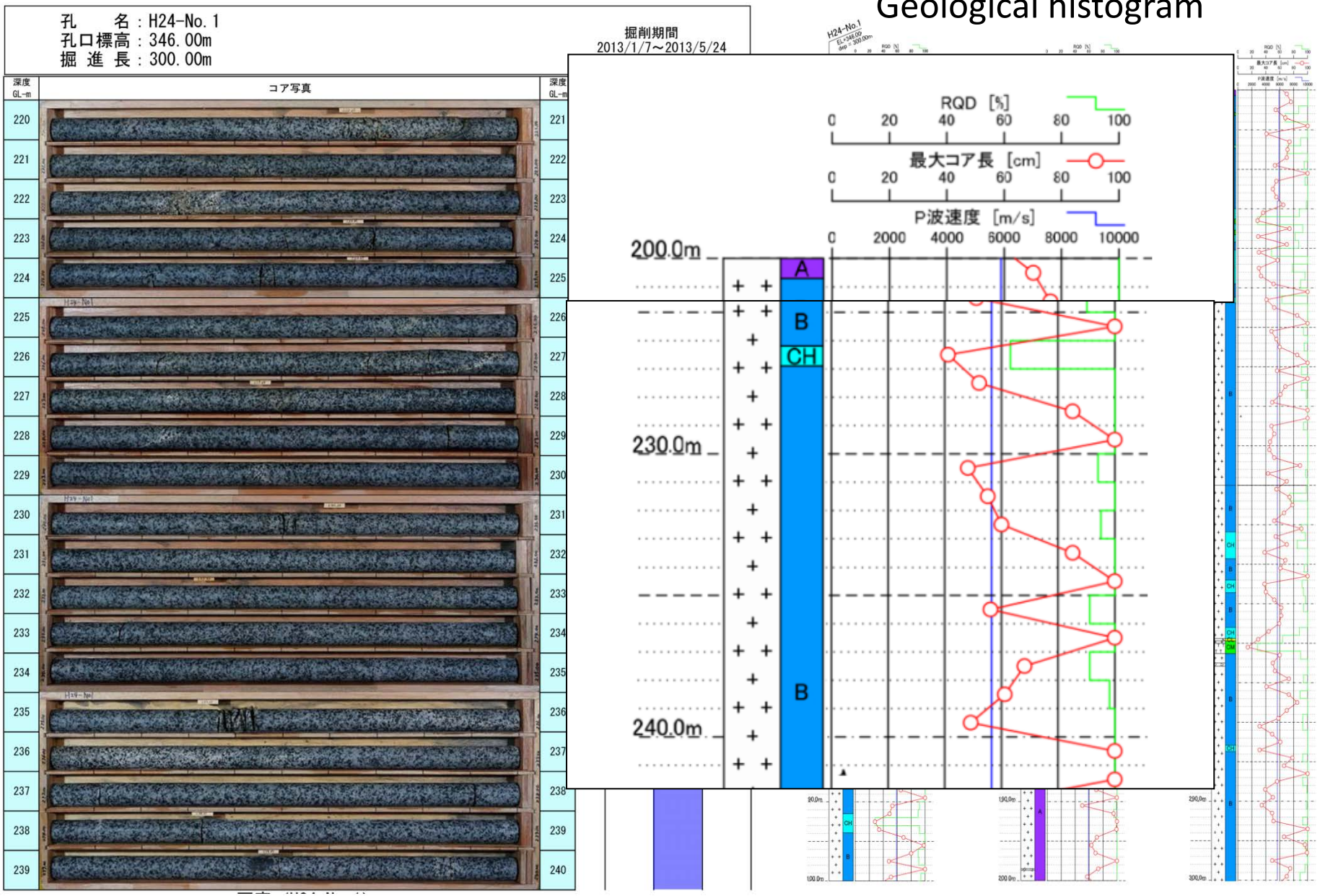
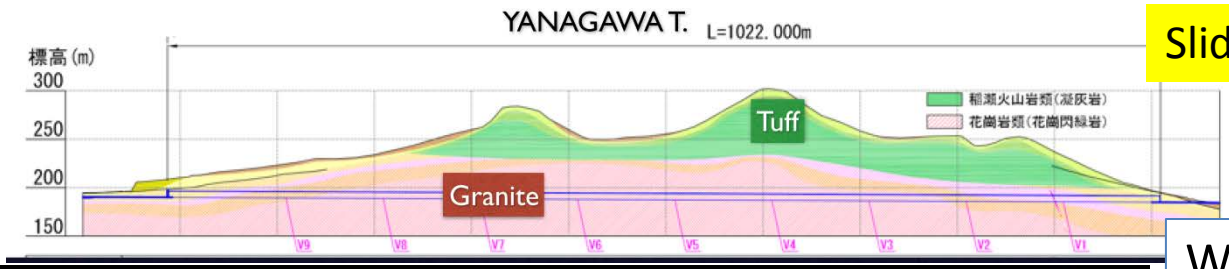


図 2.84: 簡易柱状図

Boring samples at around the collision point, very good, no crack

Geological survey

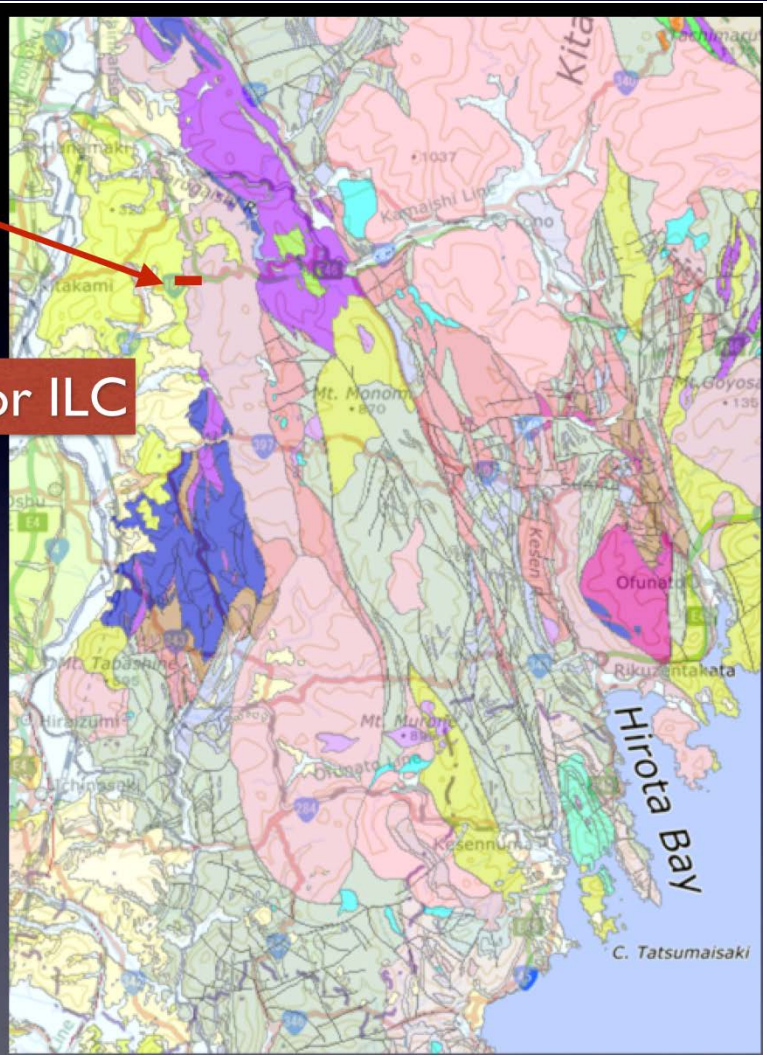


Slide by Tomo Sanuki (Tohoku Univ.)

We have a real road tunnel excavation example, coincidentally, in the same rock as ILC with same NATM (blasting method), similar to ILC access and main tunnel excavation.

YANAGAWA Tunnel
L=1,022m

"Pilot tunnel" for ILC

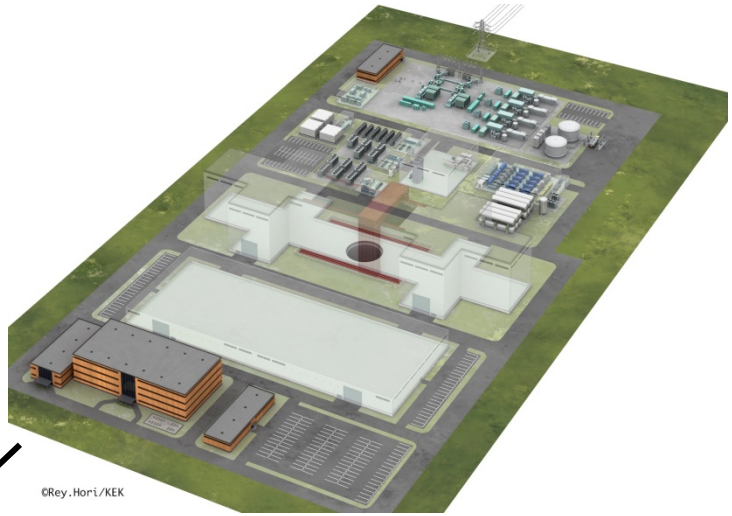


fresh granite
2017.9

A proposal of Surface Access stations

A proposal of
site-specific design of
Surface Access stations.

surface design
access stations
16,600m^2 × 5 area
to be further discussed.



PM-10

electron linac

PM-8

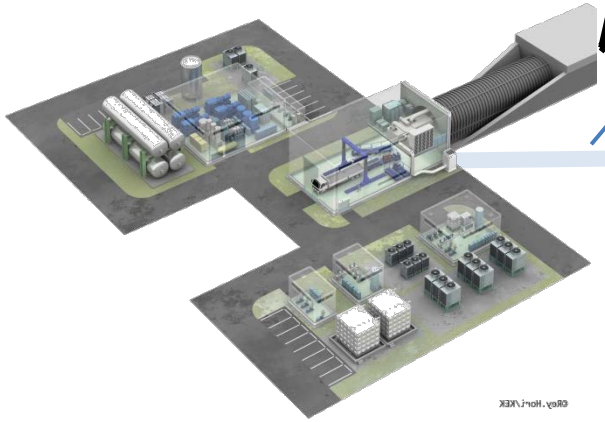
Interaction Region

damping ring

PM+8

positron linac

PM+10

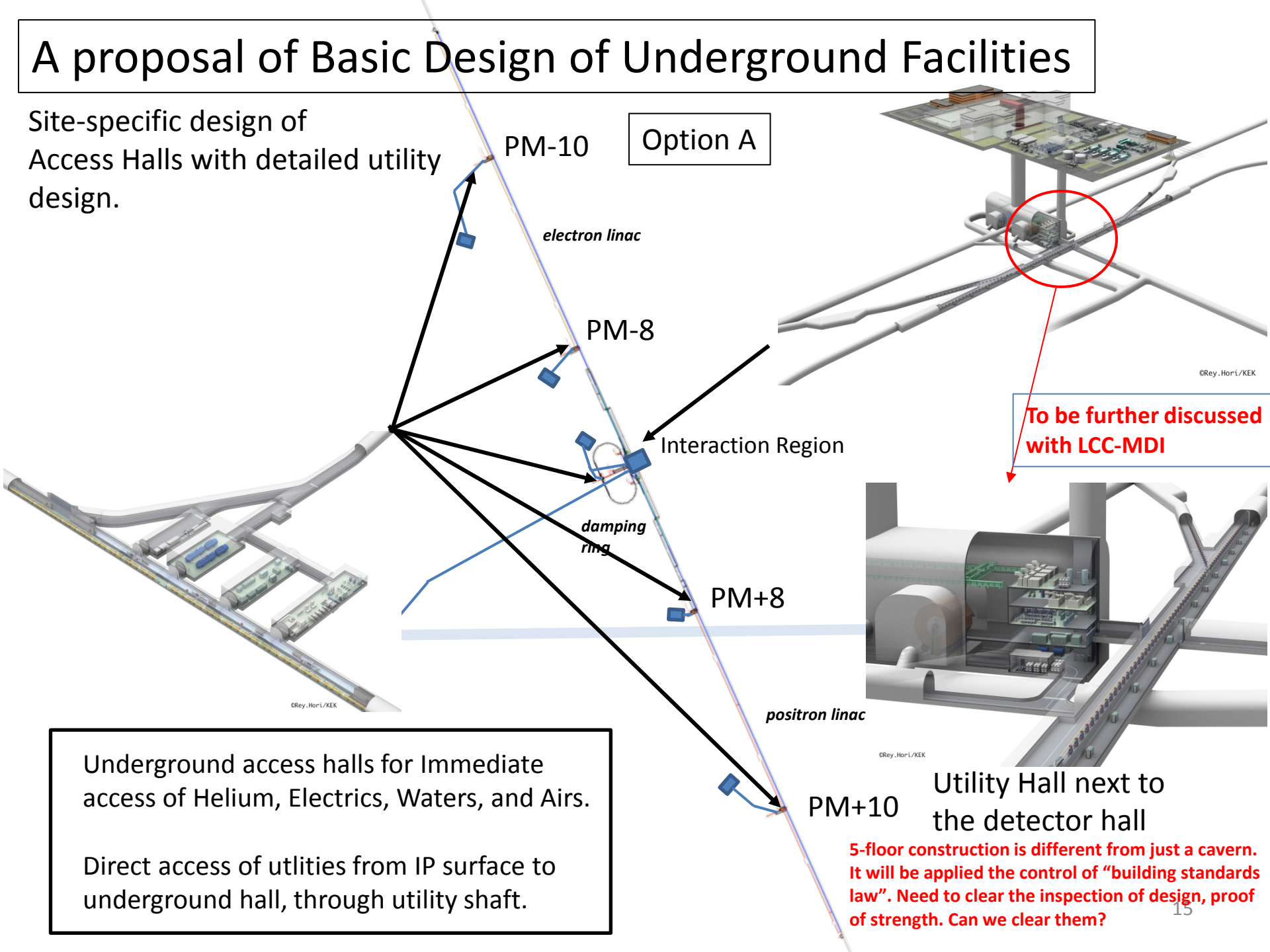


surface design
IP area 78,500m^2
to be further discussed especially with LCC-MDI.

A proposal of Basic Design of Underground Facilities

Site-specific design of
Access Halls with detailed utility design.

Option A



To be further discussed with LCC-MDI

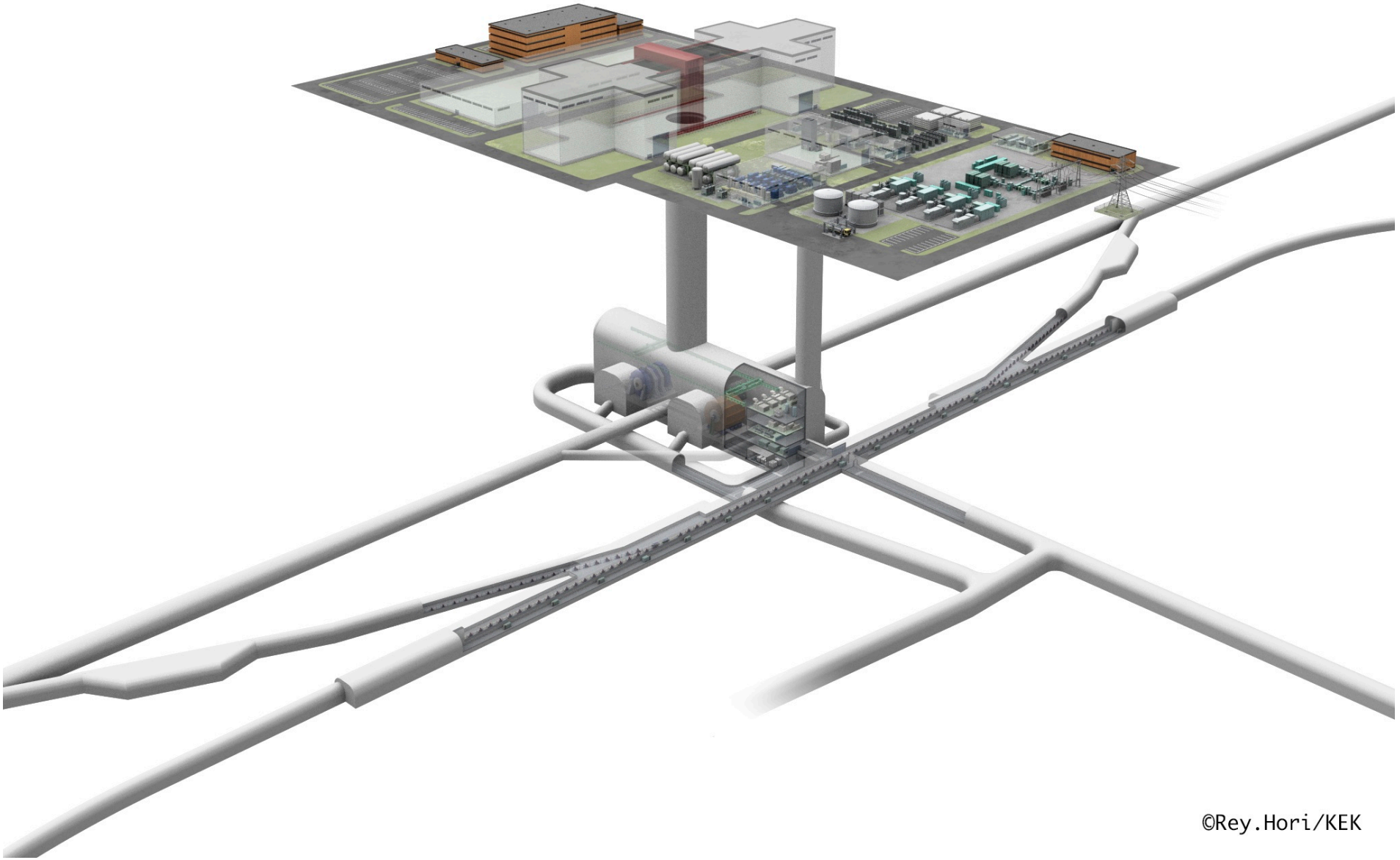
Utility Hall next to the detector hall

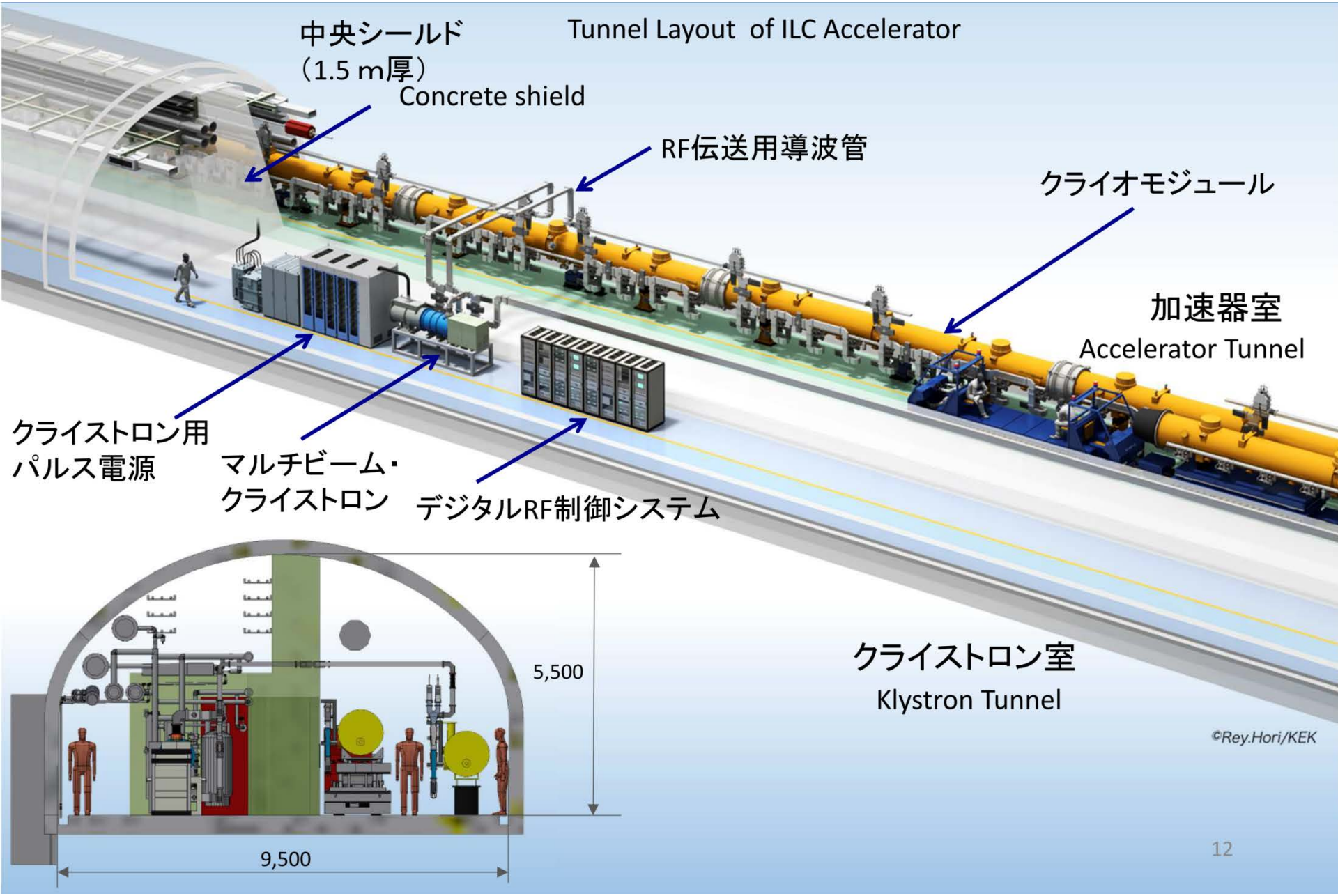
5-floor construction is different from just a cavern. It will be applied the control of "building standards law". Need to clear the inspection of design, proof of strength. Can we clear them?

Underground access halls for Immediate access of Helium, Electrics, Waters, and Airs.

Direct access of utlities from IP surface to underground hall, through utility shaft.

A proposal of Basic Design of Interaction Region Facilities



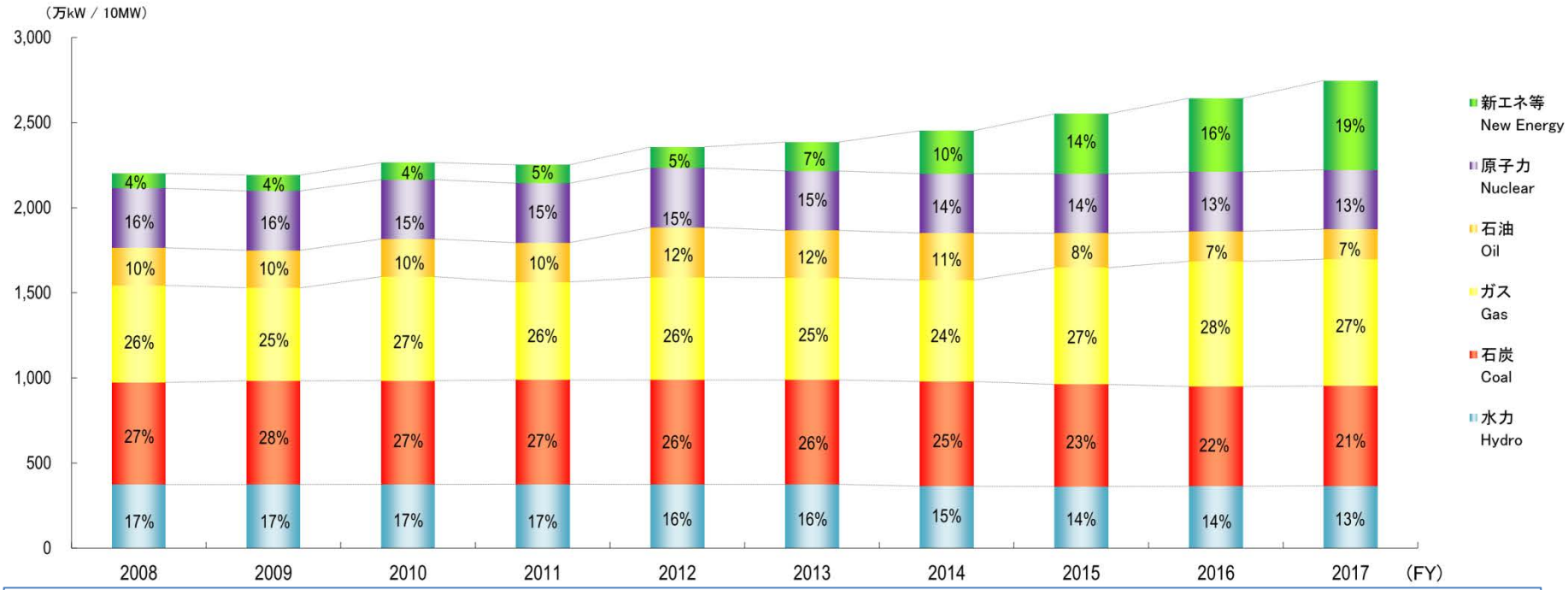

中央シールド
（1.5 m厚）
Concrete shield
Tunnel Layout of ILC Accelerator
RF伝送用導波管
クライオモジュール
加速器室
Accelerator Tunnel
クライストロン用
パルス電源
マルチビーム・
クライストロン
デジタルRF制御システム
5,500
9,500
クライストロン室
Klystron Tunnel
©Rey.Hori/KEK

Green ILC

Electric power supply (Generating Capacity) in Tohoku Region

1. 電力供給 Electric Power Supply

（1）発電設備容量構成比（含他社受電） Generating Capacity by Energy Source (including purchased power)



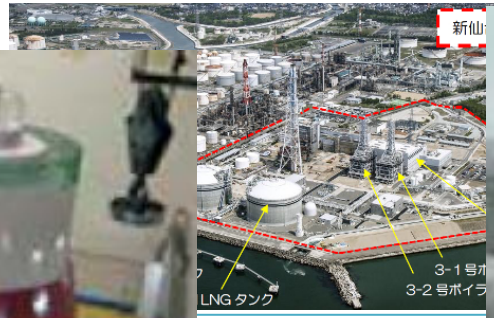
JPY2017 Total 27.47GW

Hydro: 3.66 (13%), Coal: 5.87(21%), Gas: 7.44(27%), Oil: 1.77 (7%), Nuclear: 3.49(13%), New Energy (Wind, Solar, Biomass, Waste and Geothermal) : 5.24 (19%)

Sustainable electric power total (New energy + hydro) = 32% (Increasing year by year)

Actual supply by sustainable power is 22% and also increasing

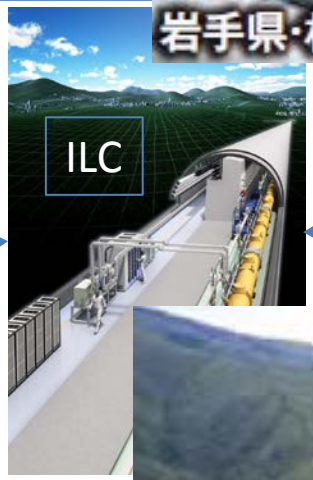
All nuclear power plants in Tohoku are not working since after March 11, 2011 disaster



o stage power ge

rcial grid consis
type generato

GS



Wind

Solar

s

Collaboration between
Iwate University,
National Institute of Industrial Science and Technology,
Takasago Thermal Engineering Co., Ltd. (Tokyo)
and
Higashinihon Kiden Kaihatsu Ltd. (Iwate)

Waste heat utilization by using
the heat storage absorbent

Waste heat energy recovery and its off-line transportation

Transportation of heat energy using "HAS-Clay" by container truck

Principle of "HAS-Clay"

➔ Sintered nano-scale compound of
Hydroxy Aluminum Silicate + Amorphous Aluminum Silicate

➔ Phase transition of H_2O (Vaper ⇔ Water) + Chemisorption

➔ HAS-Clay: "Adsorbent" developed by the National Institute of Advanced Industrial Science and Technology (AIST)

- Specific gravity 1.2
- Adsorbed moisture content 0.37kg/kg
- Volume filling rate 50%
- Heat storage density **580 MJ/m^3**

➔ 12 times of energy of natural gas (45 MJ/ m^3)

Energy recovery from waist heat of factory, incineration plant, co-generation, solar and etc.

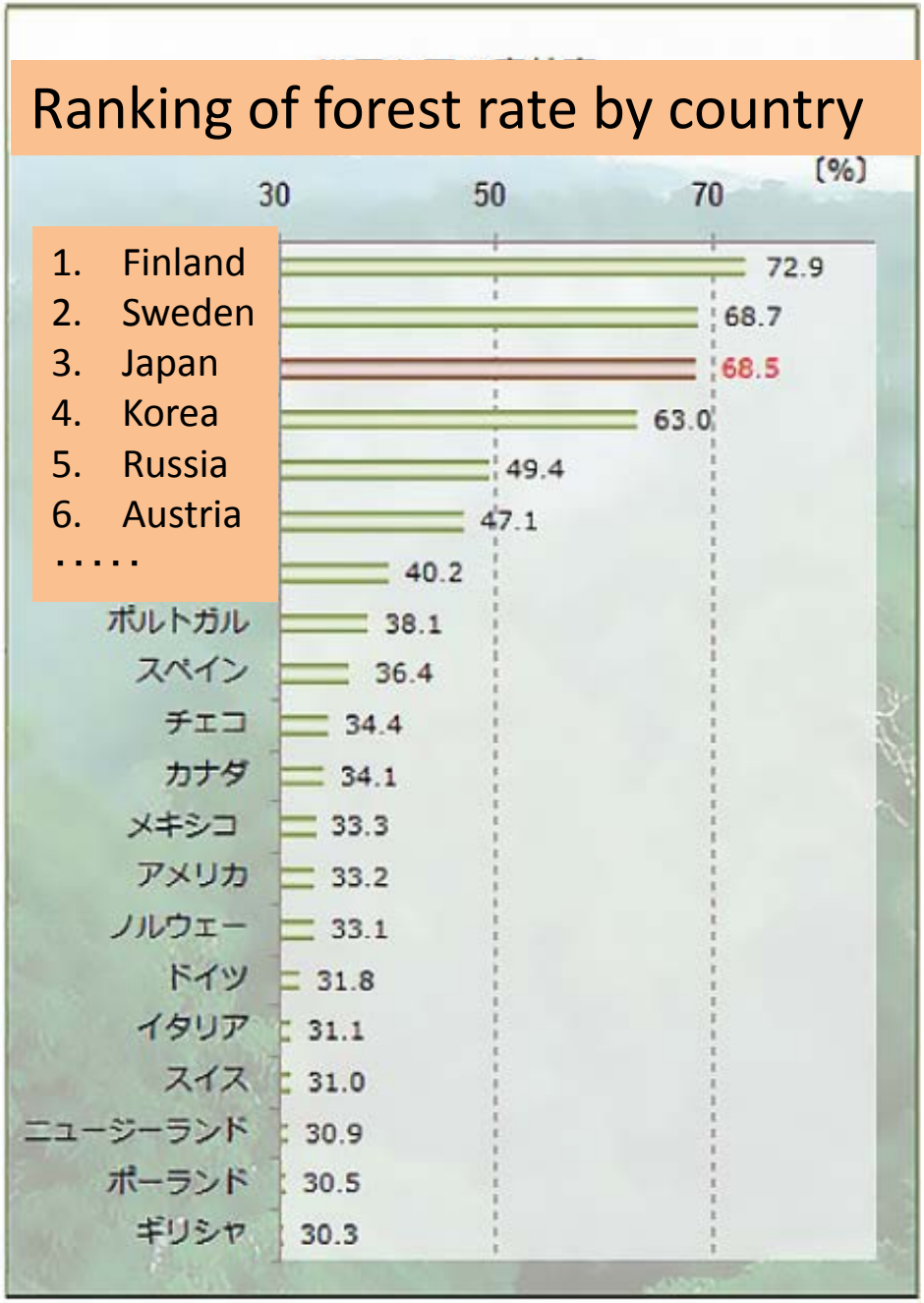
Heat utilization business: Greenhouse agriculture, wood and biomass drying, heat supply business for community and etc.

Firstly, we have to increase the wood demand to increase the biomass unused

ILC-related facility (laboratory buildings, guest houses, and etc.) should be “Wood first” by taking advantage of the characteristics of the Tohoku region

Collaboration
between
Iwate University
and
Shelter Co., Ltd. (Yamagata)

Shelter®
株式会社シェルター

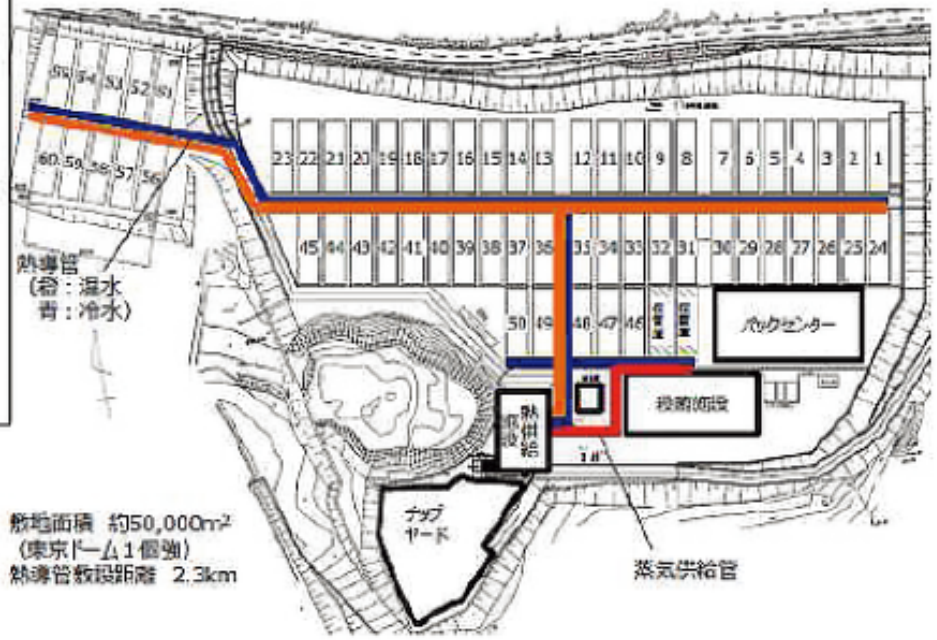


出典：森林・林業学習館

Unused biomass

We have to remind as follows:

- Japan is one of the largest forest nation (proportion of forested land, not the total area)
- Effective utilization of forest resources is in our mission
- The ILC is not exceptional



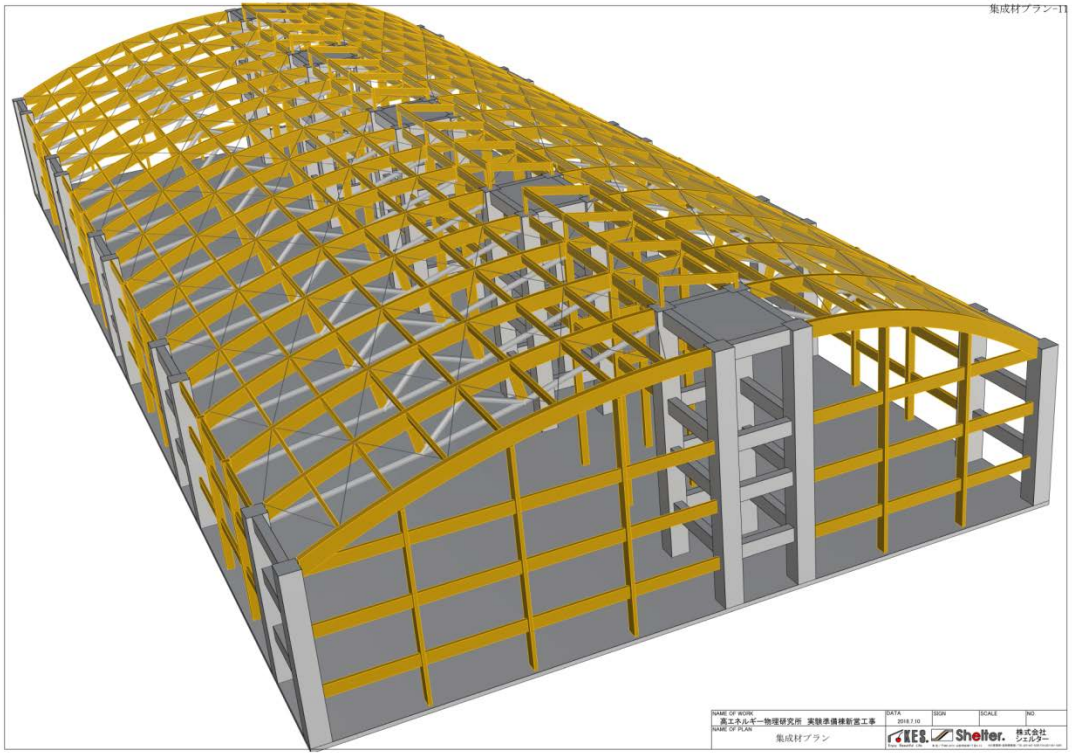
Example of utilization of unused biomass in Iwate prefecture

Bark of hardwood is smashed and dried (500 MJ/m^3)

Large scale plant of fungal bed cultivation of shiitake mushrooms

出典：久慈バイオマスエネルギー（KBEC）、東北大学大学院環境科学研究科
第106回コロキウム環境

We are making a design of detector assembly hall (50m X 120m) of ILC, based on the hybrid structure of wood and RC by this collaboration.



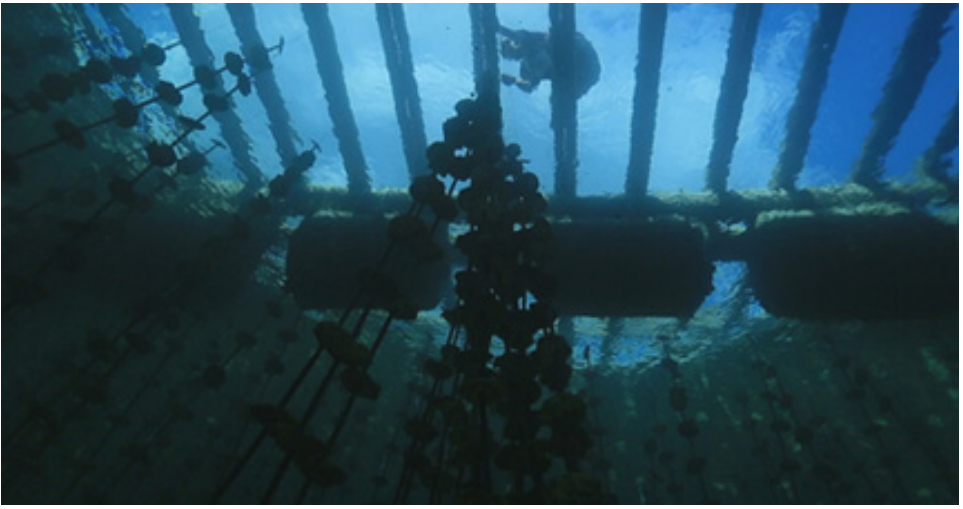
Study results

- Cost:

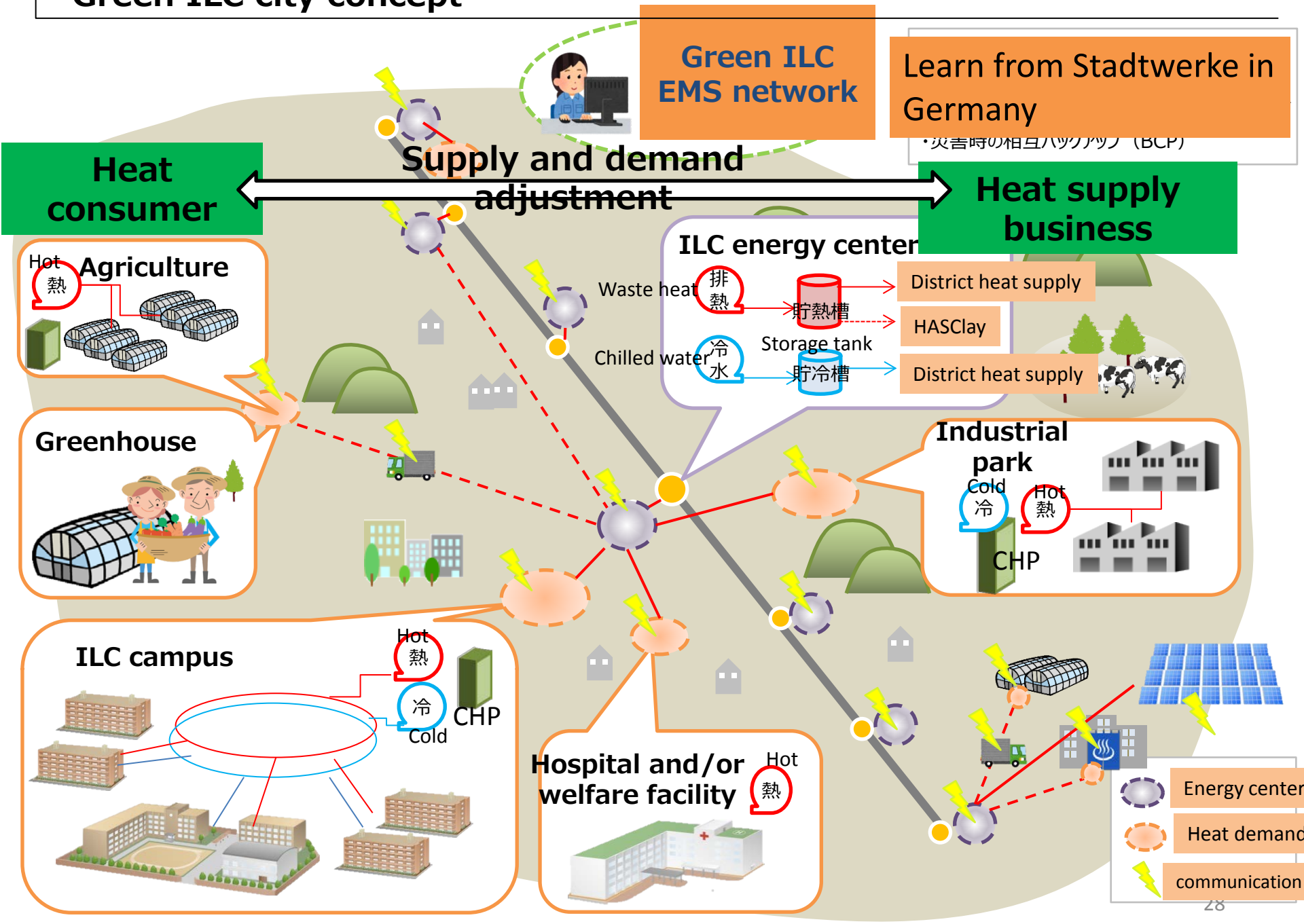
Steel frame + RC >wood + RC by 20%

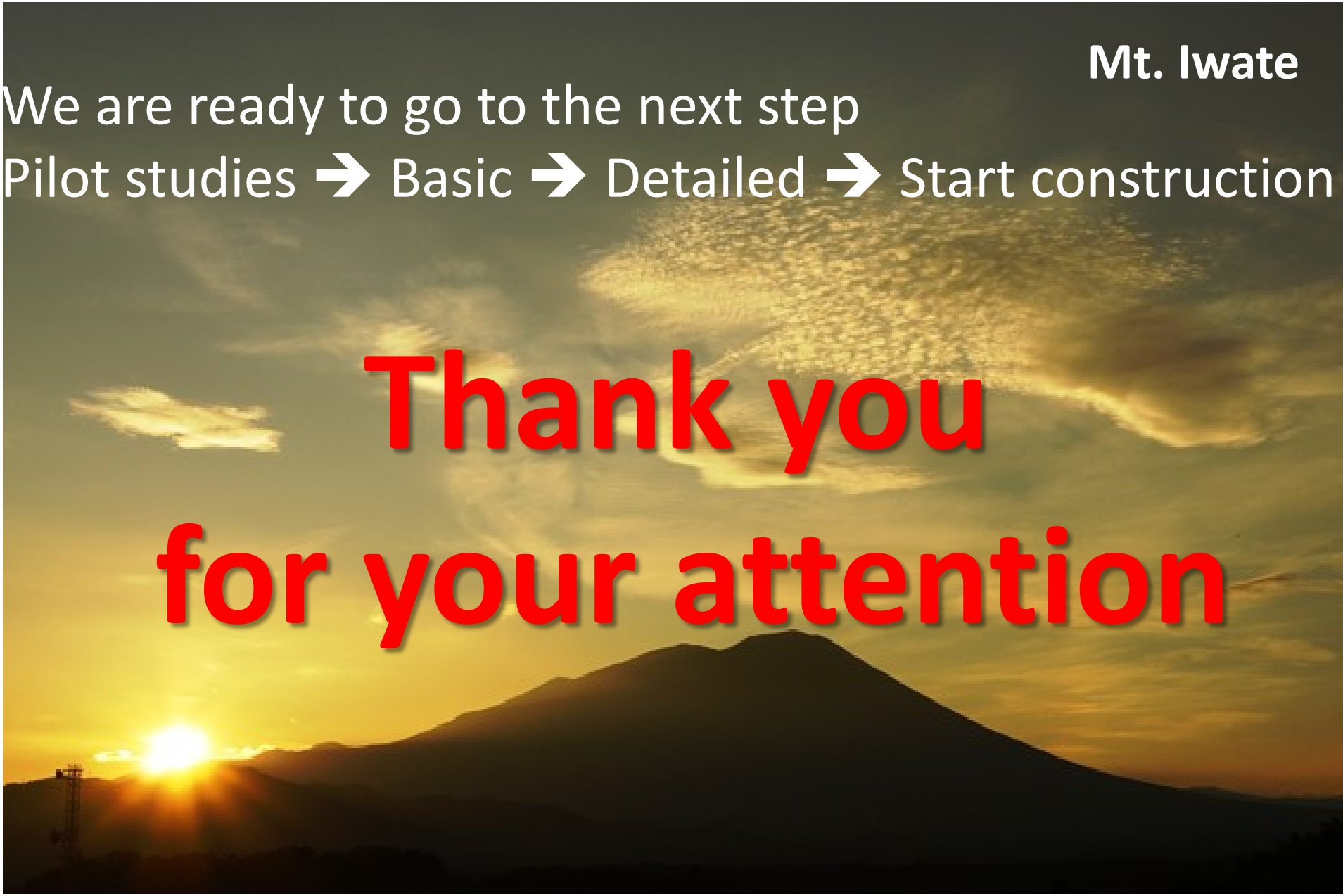
- Larger economic ripple effect
- Larger employment-induced amount

In Japan, we have sufficient sustainable energy



Green ILC city concept





We are ready to go to the next step

Pilot studies → Basic → Detailed → Start construction

Thank you for your attention