

Ground Displacement at BL29XUL – 1km Beamline – in SPring-8

To evaluate possible long-term deformation of the XFEL building, we have surveyed the deviations of the beamline component of BL29XUL from the initial locations.

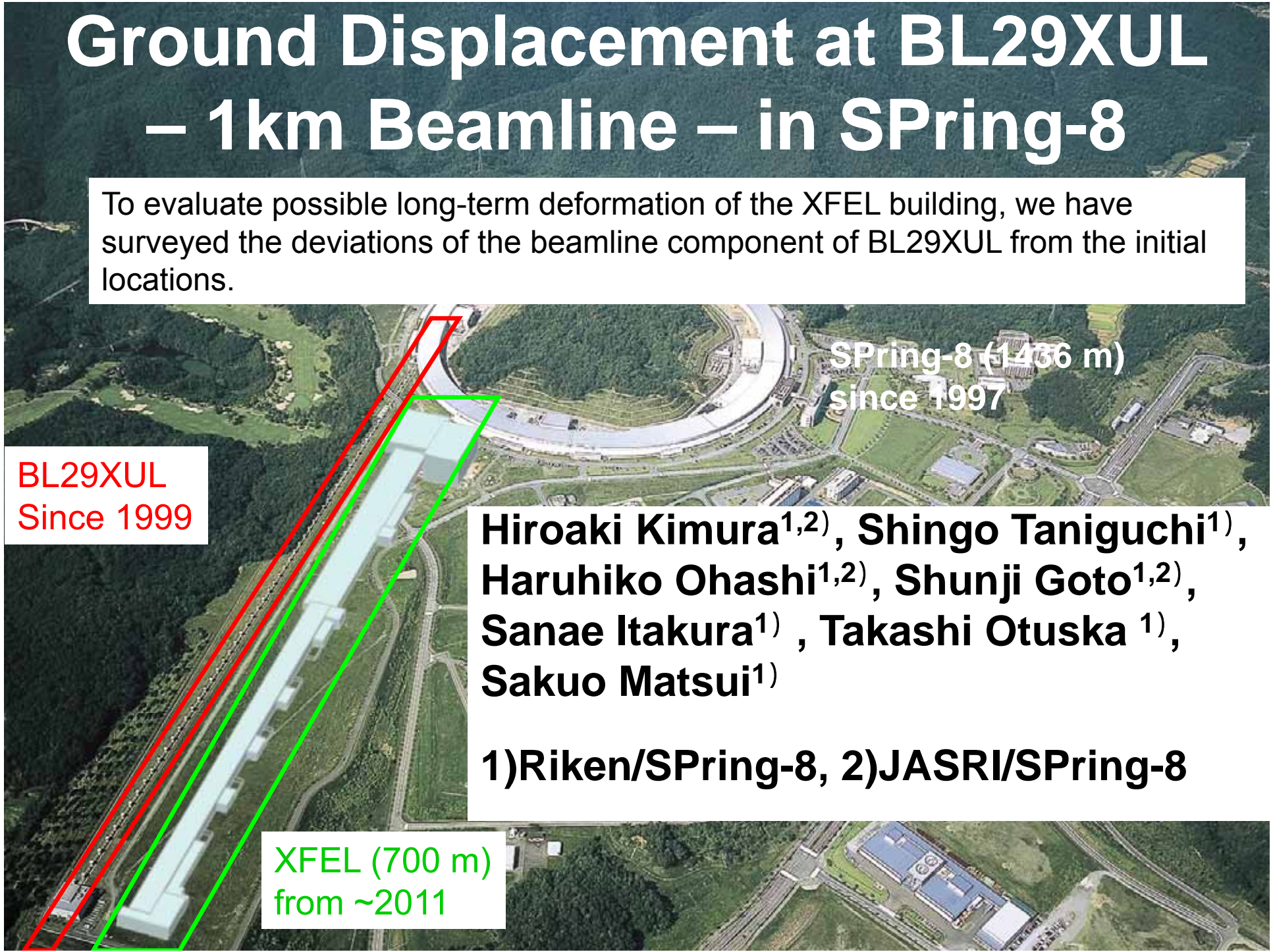
BL29XUL
Since 1999

SPring-8 (1436 m)
since 1997

**Hiroaki Kimura^{1,2)}, Shingo Taniguchi¹⁾,
Haruhiko Ohashi^{1,2)}, Shunji Goto^{1,2)},
Sanae Itakura¹⁾, Takashi Otuska¹⁾,
Sakuo Matsui¹⁾**

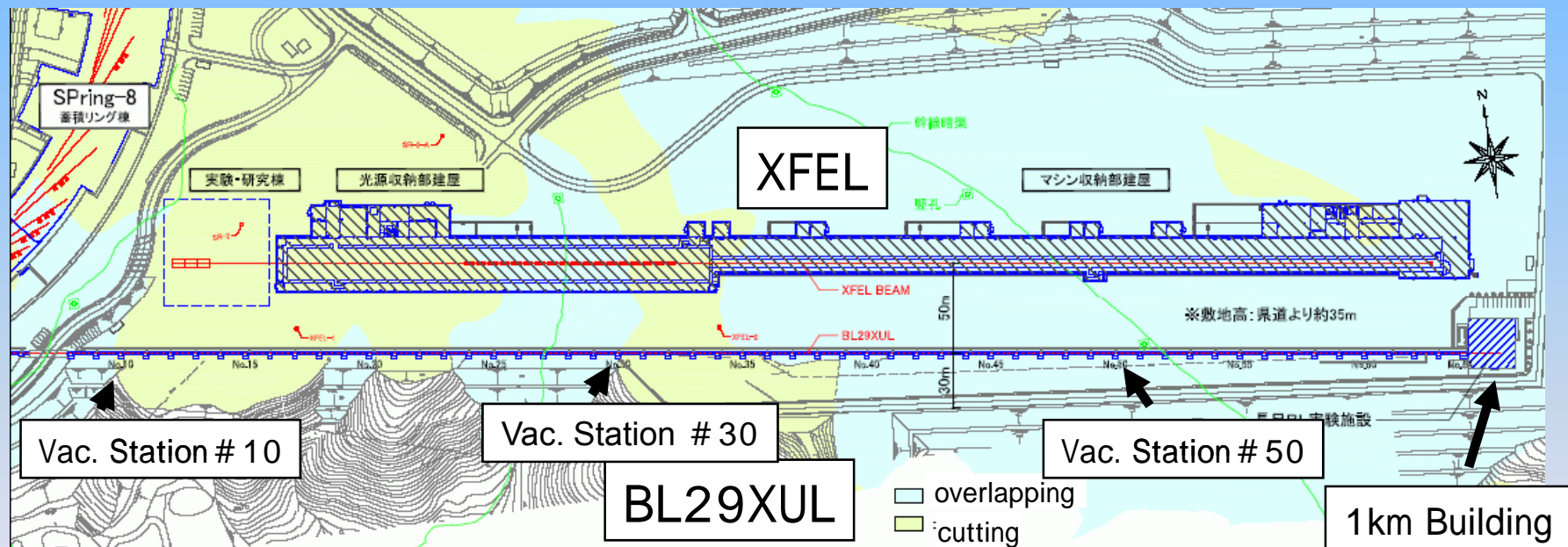
1)Riken/SPring-8, 2)JASRI/SPring-8

XFEL (700 m)
from ~2011



Outline

1. History and structure of BL29XUL
2. Survey measurement and Result
3. Understructure of XFEL building
4. Summary



Out door section of BL29XUL



1. History

- 1990: Ground breaking**
(Max. of thickness of new layer: 55m)
- 1999: Construction of BL29XUL**
- 2007: Survey**



2. Structure

Transport channel

Beam pipe: outside dia. 114mm
length ~ 900m

Vac. Pump station: #64, 13.6m pitch

Understructure: Concrete
0.5m thick
2m wide

1km building

Understructure :

Concrete pillars :
length ~ 30m
contacted on weathering bedrock.

Survey - level

Digital level

Trimble DiNi12
for measuring level of basement



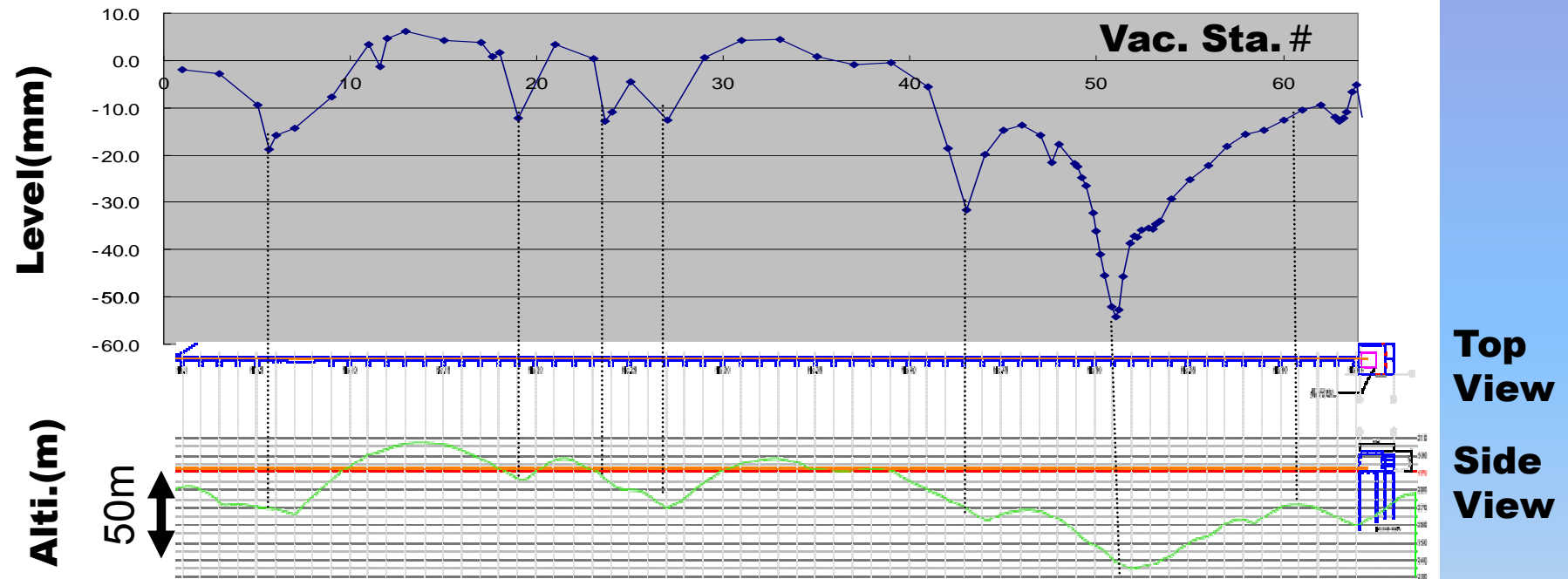
Optical level

Nikon AS-7
for measuring height of beam pipe
from the basement



Result - level

Vac. Sta. : 13.6m pitch



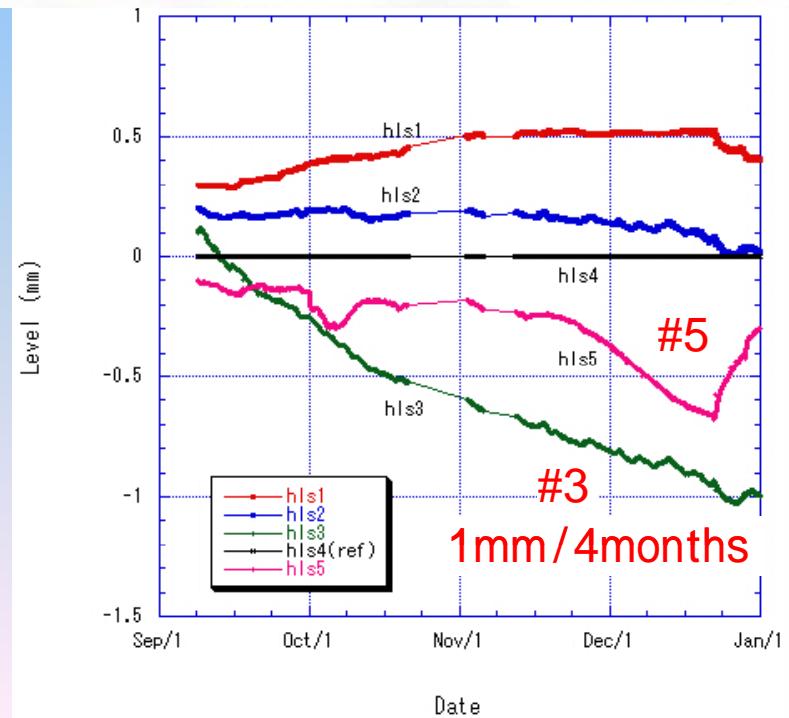
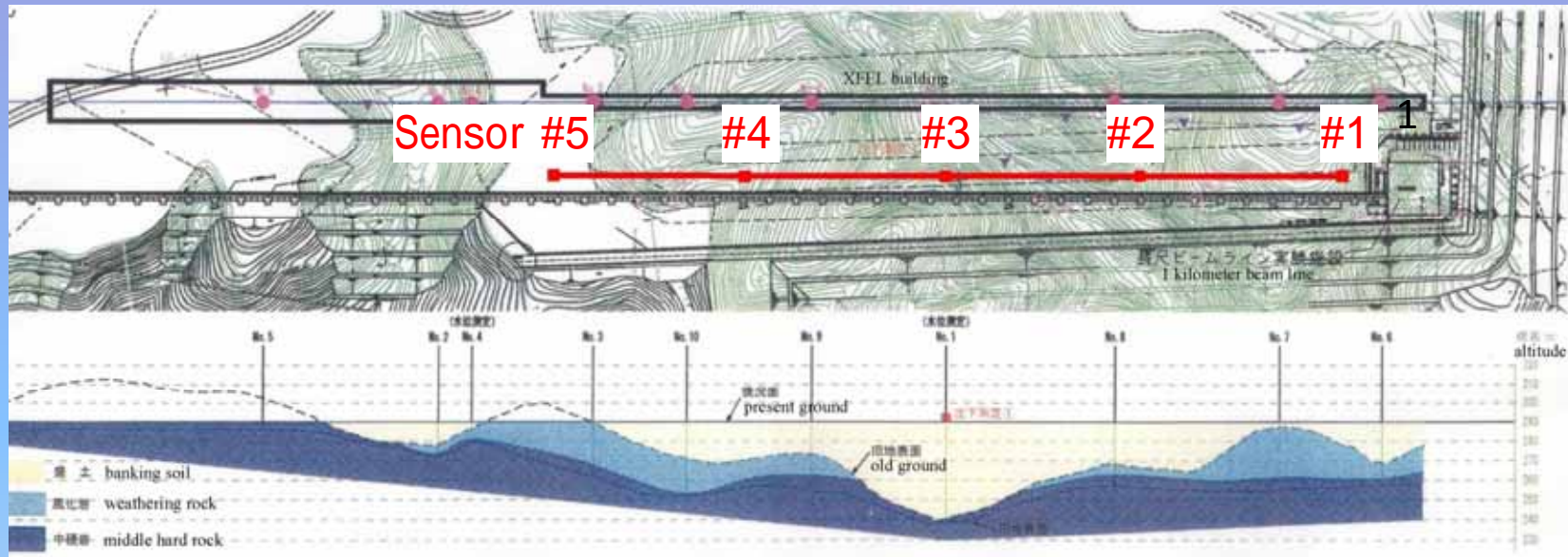
Measured Subsidence of #51: 54 mm (7mm / year)
of 1km building : 5mm

The shape of the obtained subsidence data was very similar to that of the geographical features before the land preparation.

The subsidence is occurred at not only near surface part of embankment but also all of that.

HLS measurement

Poster by C. Zhang



Survey - Lateral

GNSS survey system

(for several points)

Topcon Net G3 × 2

Static relative positioning method

It can use satellites of GPS and GLONASS

Measuring time: 12 ~ 15min/1point

Reproducibility: $\pm 1\text{mm}$ (by $5 \times 10\text{min}$ data)

Precision: $\pm 2\text{mm}$ (in data sheets)

→ **Friday, Dr. Matsui, Oral Presentation**



Total station (for all points)

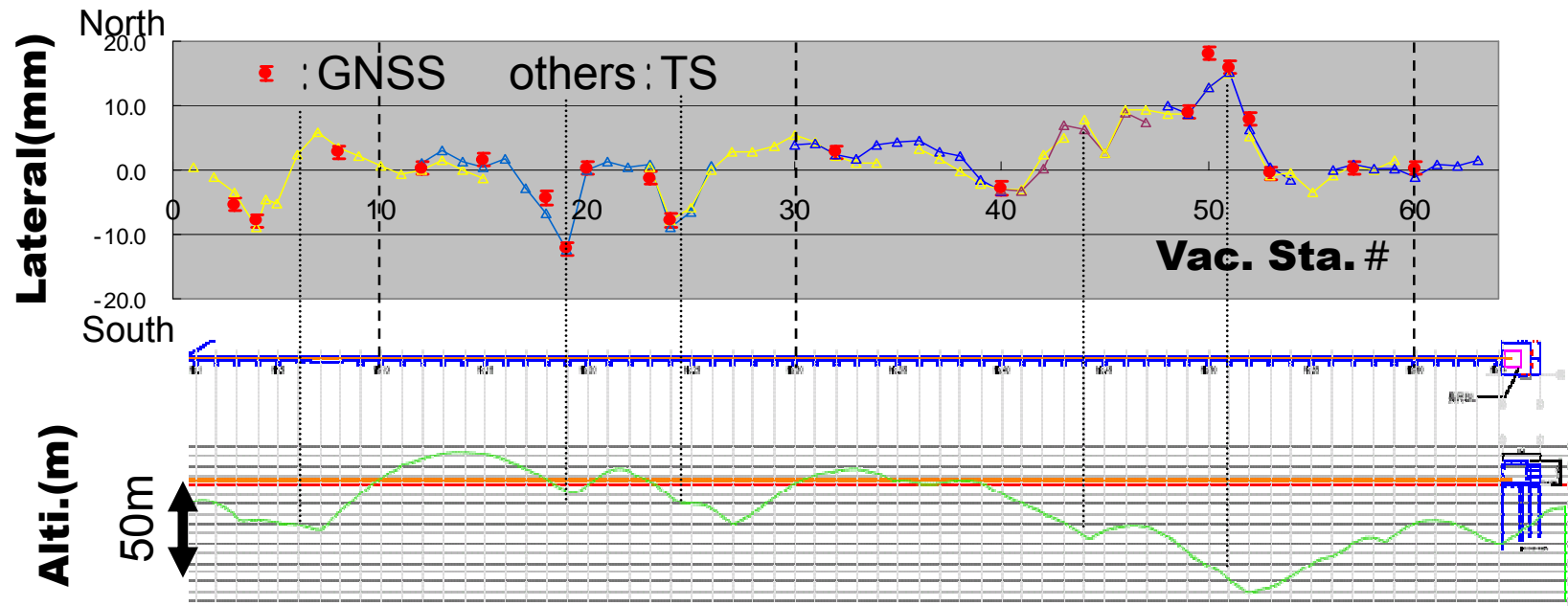
Leica TM5100A

**With scale aligned along sight line
and contacted to beam pipe**

Relative measurement



Result-Lateral



**Top
View**

**Side
View**

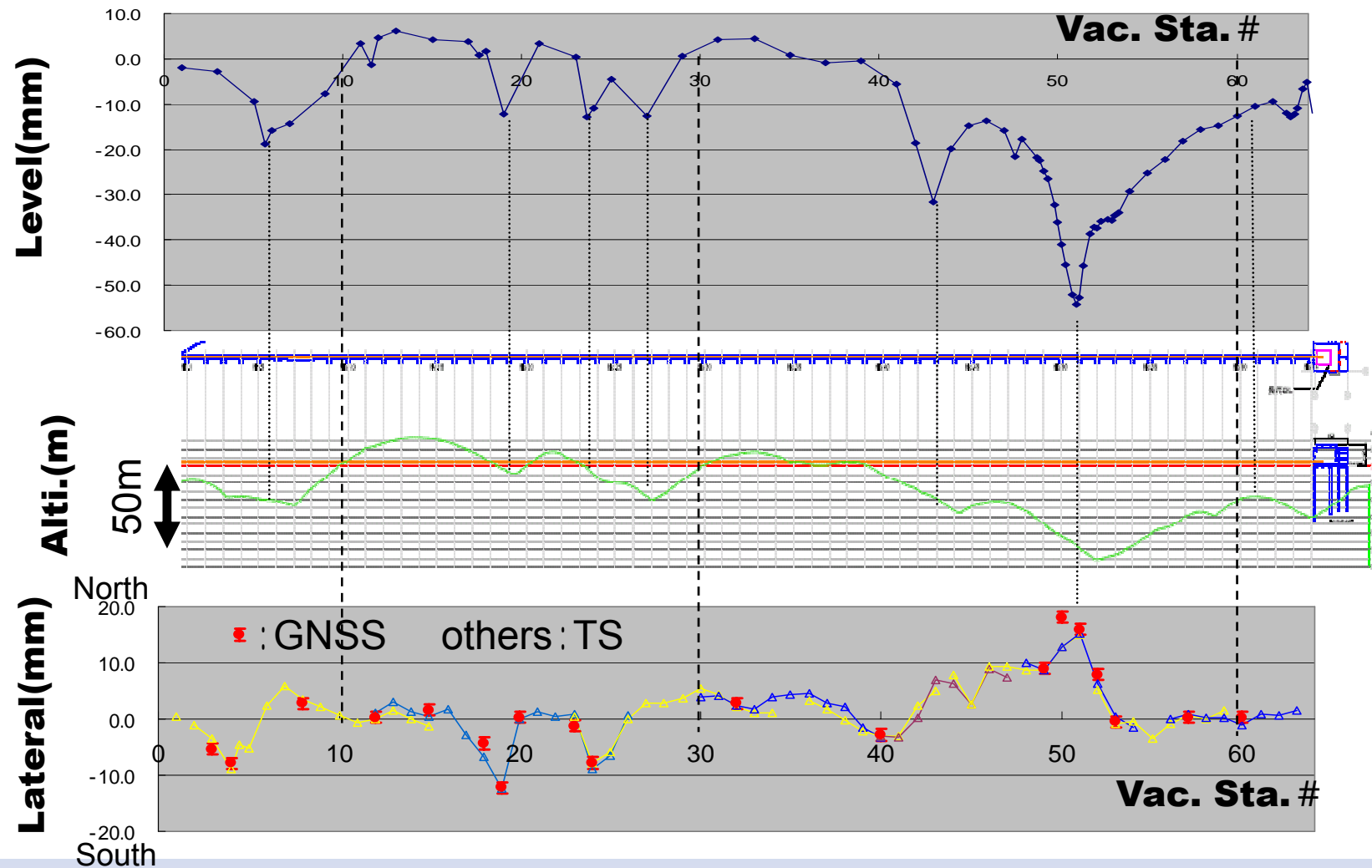
Lateral: Original line was decided by point #12 and #60

Inclination of supports of beam pipe

- Measured data of inclination < 0.15 deg. (→ 5.6mm shift)
 - Initial inclination < 0.2 deg.
 - The data have not changed systematically.
- Inclination of supports or basement is disregarded.

Displacement : -12 ~ +15mm

Result



Top View

Side View

Ground displacement depends on that of embankment.

→ Accelerator section of XFEL building (located at #35 - #64)

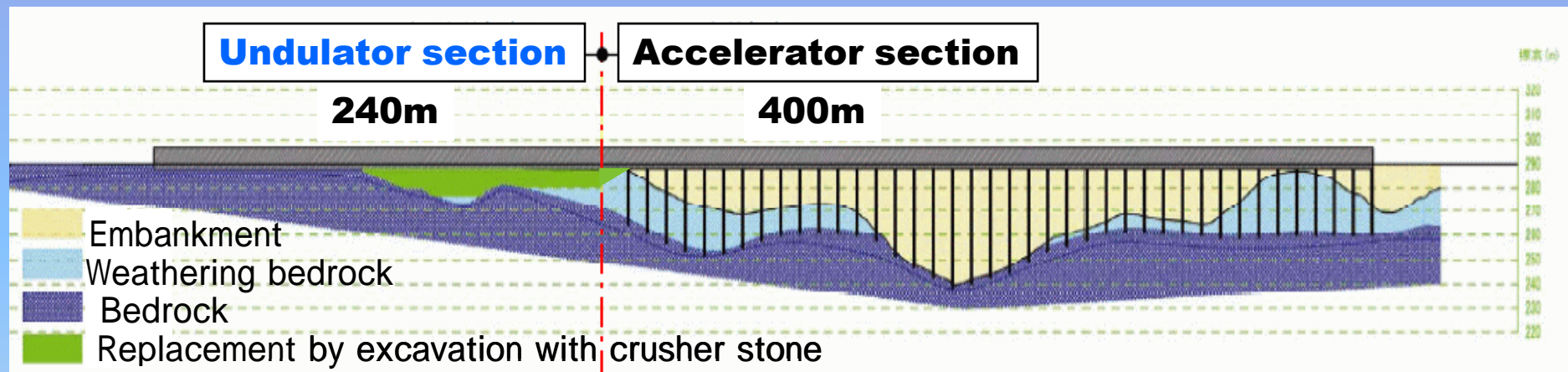
Level: Subsidence at #51: 54mm (8mm / year)

Lateral: Displacement : ~ - 5 ~ +15mm

Understructure of Undulator section

Alignment tolerance of component at installation : ± 0.1 mm

(at final : ± 0.01 mm Next talk by Dr. Yabashi)



Bedrock or Replacement with crusher stone.

(the packing ratio of the weight density: 95%)
independent from the displacement of embankment
very good

subsidence < 2mm / 10years

Undulator Section

Replacement by excavation with crusher stone



Excavation Operation



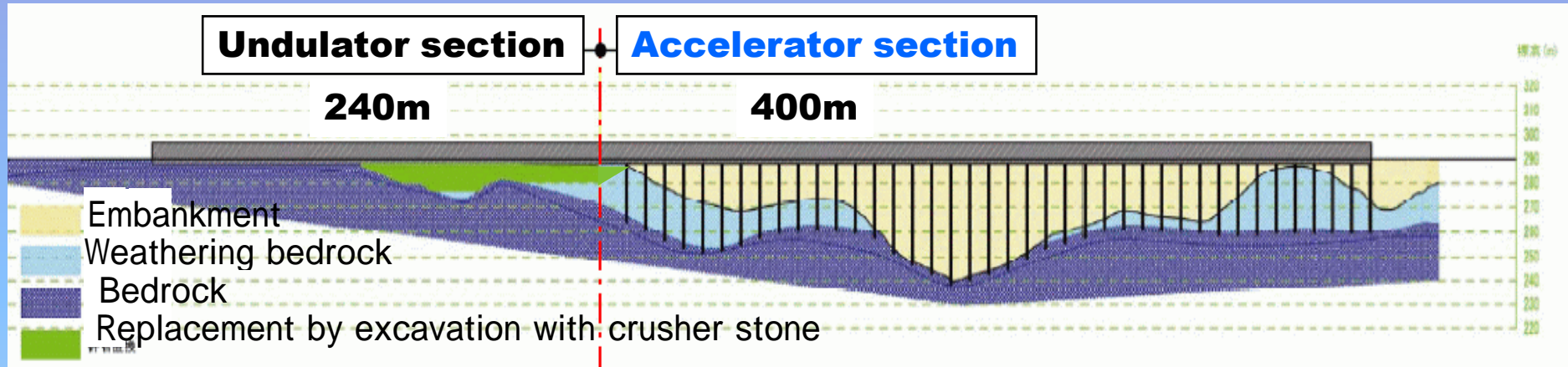
Surface of Bedrock



Paving with crusher stone

Understructure of Accelerator section

Alignment tolerance of component at installation : $\pm 0.3\text{mm}$



Concrete pillar

Total #:139 Diameter: 1.5 or 1.6m

Length :19 -52m (Ave. 30m)

lateral : bad depend on embankment

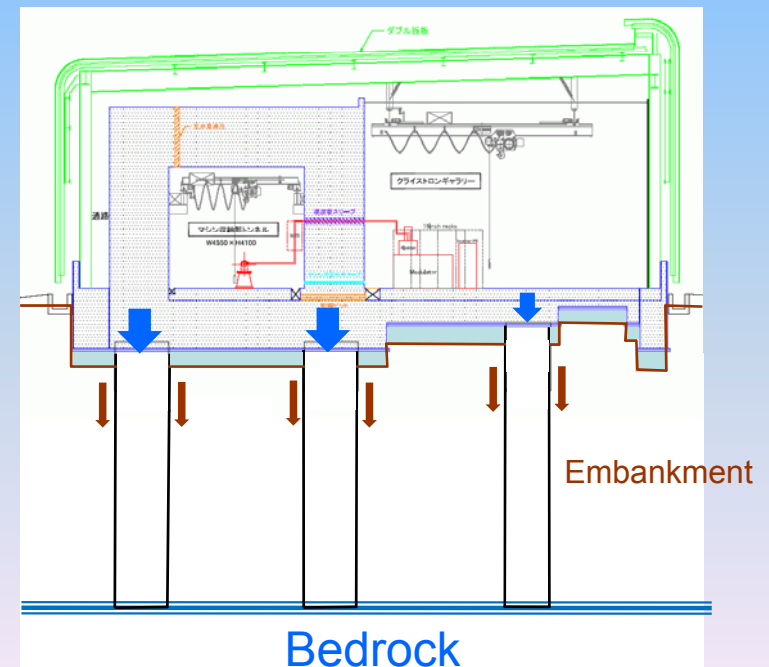
level : good,
but shrinkage
in drying process

10mm / 10years for 50m pillar

and

by down force from subsided embankment

5mm / 10years for 50m pillar



Accelerator Section

Piling for a foundation of the building

- Now all pillars have been piled.



Basement Pillar Construction



Pillar Casing Bit with Diamond Blades



Press Fitting of the Pillar Casing

XFEL Facility

- XFEL building will be completed in March 2009.
- Accelerator and undulator will be installed from autumn 2009.



May 23, 2007



Dec 27, 2007

Summary

Obtained data of displacement of BL29XUL can be reflected to accelerator section of XFEL building.

Displacement of embankment is not small.

Subsidence of the building depends on the shrinkage of concrete pillars.

- Concrete pillars shrink in drying process.
- And embankment presses pillars with a friction from side wall of these.

Total subsidence is estimated to **15mm / 10years for 50m pillar.**

- Unsupported buildings (utility backyard, side-room...) are going to subside.

Lateral displacement is estimated to **-5 ~ 15 mm.**

to accelerator

Based on these results, we designed :

Adjustment stroke of girder

Clearance of hole for wave guide

Ability of steering magnets

Several times of re - alignment is needed.