

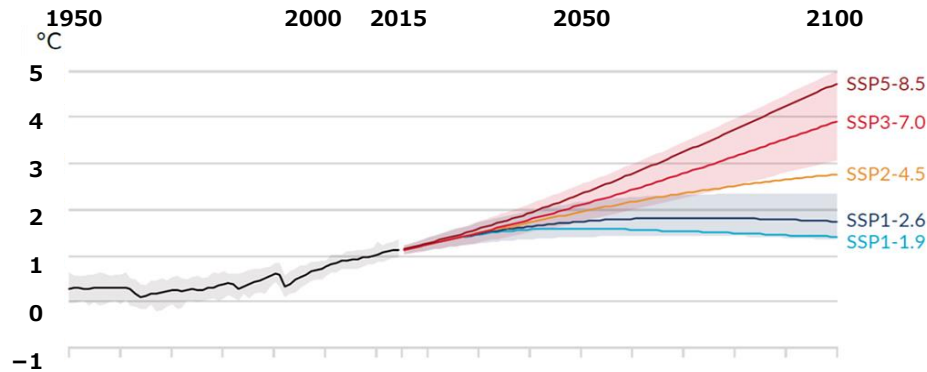
## What's New

# Japan CCS held a science class at Hokuei Children's Center on August 16, 2023 (Wed).



# Global warming and future climate

● Global surface temperature change relative to 1850–1900



The Intergovernmental Panel on Climate Change (IPCC) concluded in the 6<sup>th</sup> Assessment Report that “it is unequivocal that human influence has warmed the atmosphere, ocean and land.”

It has been pointed out that in order to limit global warming to 1.5°C, CO<sub>2</sub> emissions must be reduced to net zero by the middle of this century.

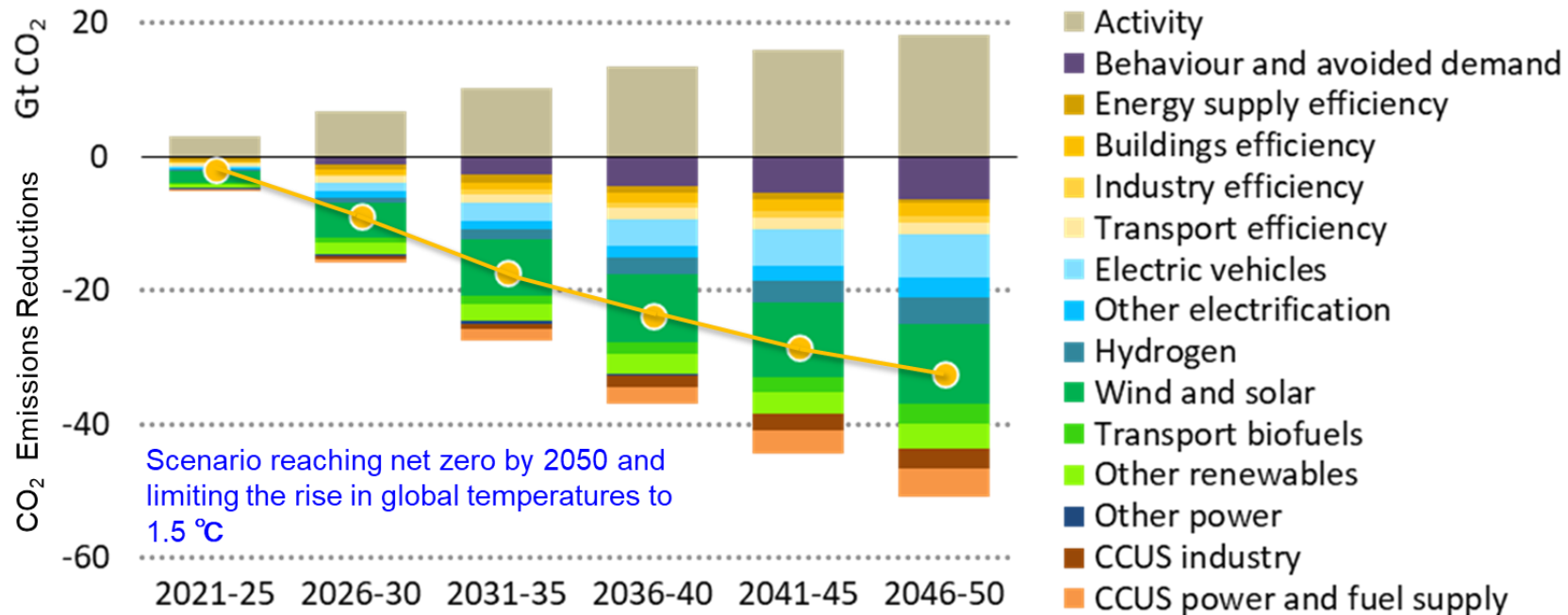
|                 |                                                                                                                                                                             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SSP5-8.5</b> | <b>Fossil fuel dependent development; no additional climate policy</b>                                                                                                      |
| <b>SSP3-7.0</b> | <b>Development under regional conflict; no additional climate policy</b>                                                                                                    |
| <b>SSP2-4.5</b> | <b>Intermediate development; additional climate policy introduced.</b><br>Global temperature rises by 2.7°C; emissions in line with aggregate NDC emissions levels by 2030. |
| <b>SSP1-2.6</b> | <b>Sustainable development; global warming held within 2°C.</b><br>Zero CO <sub>2</sub> emissions in latter half of 21 <sup>st</sup> century.                               |
| <b>SSP1-1.9</b> | <b>Sustainable development; global warming held within 1.5°C.</b><br>Zero CO <sub>2</sub> emissions in middle of 21 <sup>st</sup> century.                                  |

Source: IPCC AR6/WG1 (SPM) (Provisional version, September 1, 2021) ; as modified by Japan CCS Co., Ltd. [https://www.data.jma.go.jp/cpdinfo/ipcc/ar6/IPCC\\_AR6\\_WG1\\_SPM\\_JP\\_20220512.pdf](https://www.data.jma.go.jp/cpdinfo/ipcc/ar6/IPCC_AR6_WG1_SPM_JP_20220512.pdf)

Source (graph): Japan Meteorological Agency “Reference, Attachment 3”; as modified by Japan CCS Co., Ltd. [https://www.jma.go.jp/jma/press/2108/09a/ipcc\\_ar6\\_wg1\\_a3.pdf](https://www.jma.go.jp/jma/press/2108/09a/ipcc_ar6_wg1_a3.pdf)

# Potential of CO<sub>2</sub> reduction by CCUS

## ■ Average annual CO<sub>2</sub> reductions from 2020 in the NZE



The International Energy Agency (IEA) projects that CO<sub>2</sub> capture by CCUS will increase to 1.6Gt per year by 2030, and to 7.6Gt (~5 times 2030 levels) by 2050.

Source: Agency for National Resources and Energy  
<https://www.enecho.meti.go.jp/about/special/johoteikyoo/asiaccusnetwork.html>

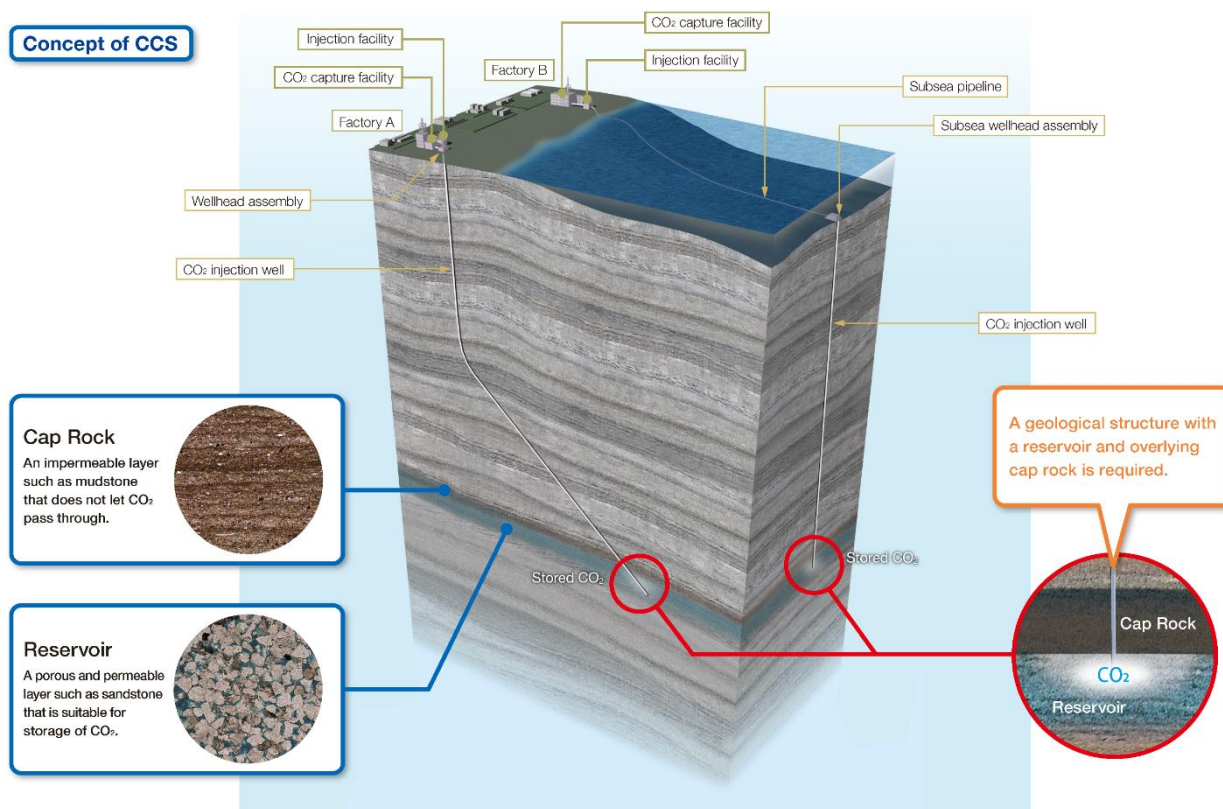
Source: IEA (2021) Net Zero by 2050: a Roadmap for the Global Energy Sector; all rights reserved; as modified by Japan CCS Co., Ltd.



# What is CCS?

## Carbon dioxide **C**apture and **S**torage

### Concept of CCS



CCS is a technology to prevent carbon dioxide (CO<sub>2</sub>) released into the atmosphere emitted by facilities such as power plants and factories. The technology involves capturing the CO<sub>2</sub>, injecting it into underground geological formations and storing it permanently. Along with energy efficiency and renewable energy, CCS helps to tackle global warming.

# How to store CO<sub>2</sub>



## ■ Features of Caprock

Mudstone etc., made of fine mud grains

- Impervious
- Sufficient blocking ability
- Covering reservoir layer widely and thickly

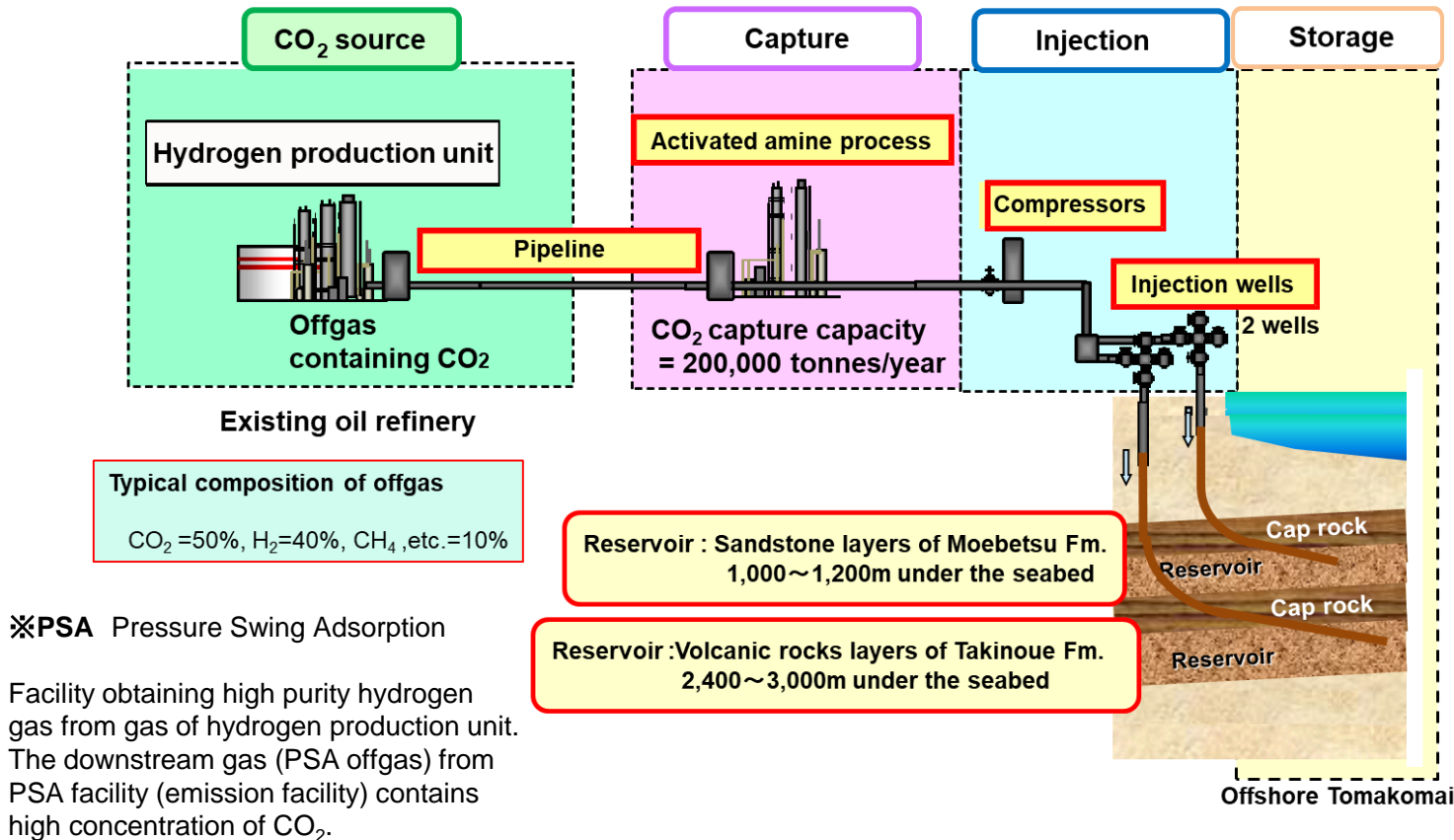
## ■ Features of Reservoir

Sandstone, volcanic rock, etc., made of coarse grains

- Sufficient pore spaces to store CO<sub>2</sub>
- Pervious

In order to store CO<sub>2</sub> in the subsurface under the seabed, a geological structure where a reservoir is overlain by a cap rock is required. The cap rock blocks the leakage of injected CO<sub>2</sub> from the reservoir.

# Flow Scheme of Tomakomai Demonstration Project



CO<sub>2</sub> is captured from the offgas containing CO<sub>2</sub> generated by a hydrogen production unit of a refinery, pressurized (up to 23 MPa) to the pressure required for injection, injected at a scale of about 100,000 tonnes of CO<sub>2</sub> per year and stored in two sub-seabed reservoirs offshore Tomakomai.

Source: Edited from the demonstration test plan at Tomakomai site,  
Ministry of Economy, Trade and Industry



# Schedule of Tomakomai Demonstration Project

Contract Period: From JFY2012 to JFY2023

■ From JFY2012 to JFY2015: Preparation

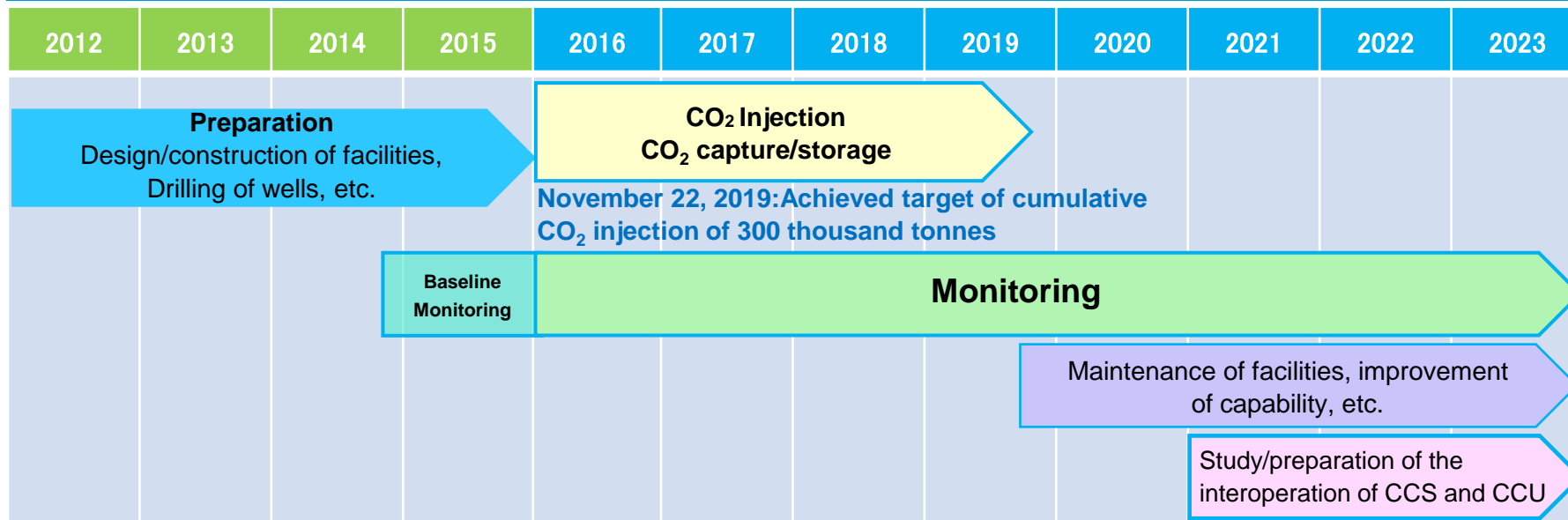
Activities including the design and construction of facilities, drilling of wells, and preparation for demonstration operation were carried out.

■ From April 2016 to November 2019: CO<sub>2</sub> injection (On November 22, 2019, the target of 300 thousand tonnes of CO<sub>2</sub> injection was achieved, and injection was terminated.)

■ From JFY2016: Monitoring of CO<sub>2</sub>(\*) ; being continued.

■ From November 2019: Maintenance of facilities, improvement of capability, etc.

■ From JFY2021: Study/preparation of the interoperation of CCS and CCU

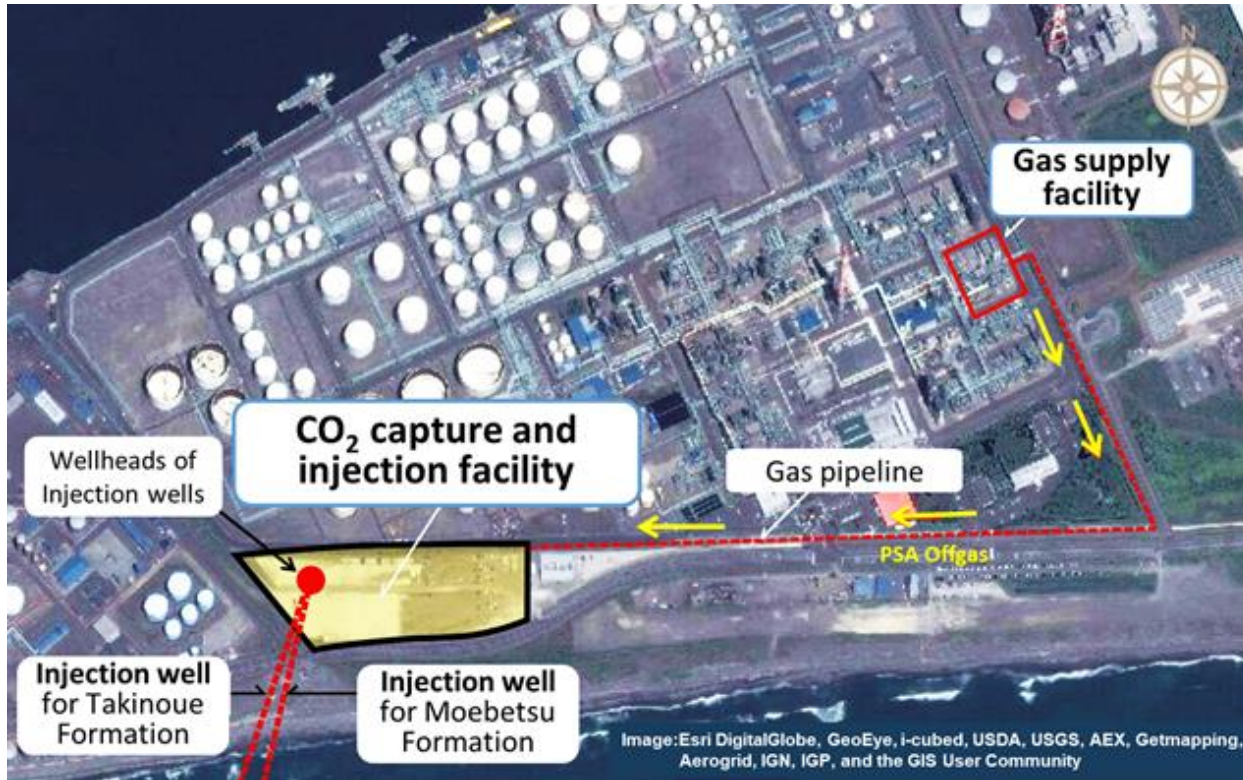


(\*) Monitoring the behavior (migration, distribution) of the injected CO<sub>2</sub>, continuous monitoring of micro-seismicity and natural earthquakes, marine environmental monitoring to detect for possible CO<sub>2</sub> seepage are being conducted.

※ Years are in Japanese Fiscal Years  
(JFY - April of calendar year to March of  
following year)

7/19

# Positional Relation of Onshore Facilities



In the "Gas supply facility", PSA offgas (CO<sub>2</sub> containing gas) is generated in the hydrogen production process of the refinery and sent to the Tomakomai Project "Capture and injection facility" via a 1.4 km gas pipeline.

At the "Capture and injection facility", CO<sub>2</sub> is captured at purity of 99% or more from the PSA offgas sent through the Gas pipeline, pressurized by compressors, and injected by 2 injection wells into offshore sub-seabed reservoirs for storage.



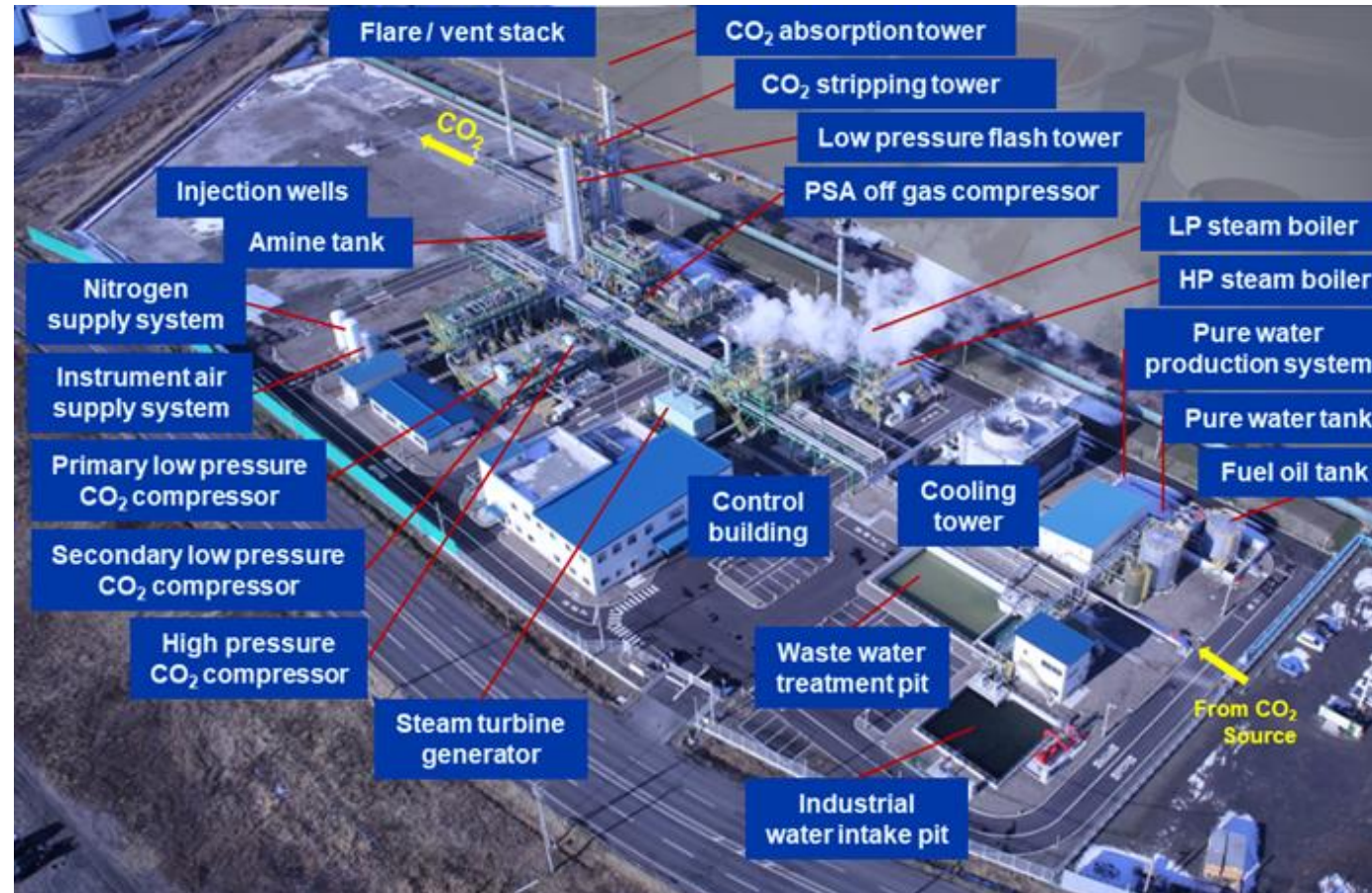
# Schematic Geological Section



This is a schematic geological section showing how the CO<sub>2</sub> is injected by two injection wells extending to the two reservoirs, the Takinoue Formation T1 Member (volcanic rocks) and Moebetsu Formation (sandstone).

The Takinoue Formation injection well is a directional well with a total depth of 5,800m and maximum inclination of 72 degrees. The Moebetsu Formation injection well is a directional well with a total depth of 3,650m and maximum inclination of 83 degrees.

# Bird's Eye View of Capture and Injection Facilities





# CO<sub>2</sub> Capture Facilities and Compressors

## 3 stage CO<sub>2</sub> Compressors

Increases pressure  
of captured CO<sub>2</sub> to  
the pressure  
required for injection



CO<sub>2</sub> Capture Facility  
Captures CO<sub>2</sub> from PSA  
Offgas



# CO<sub>2</sub> Injection Report

Injection was suspended on November 22, 2019.

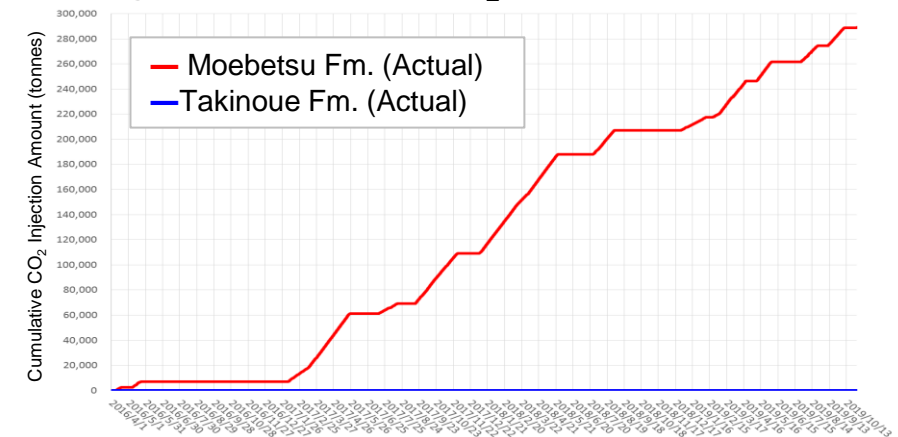
Cumulative CO<sub>2</sub> Injection amount  
(April 06, 2016~November 22, 2019)

**300,110.3**  
tonnes

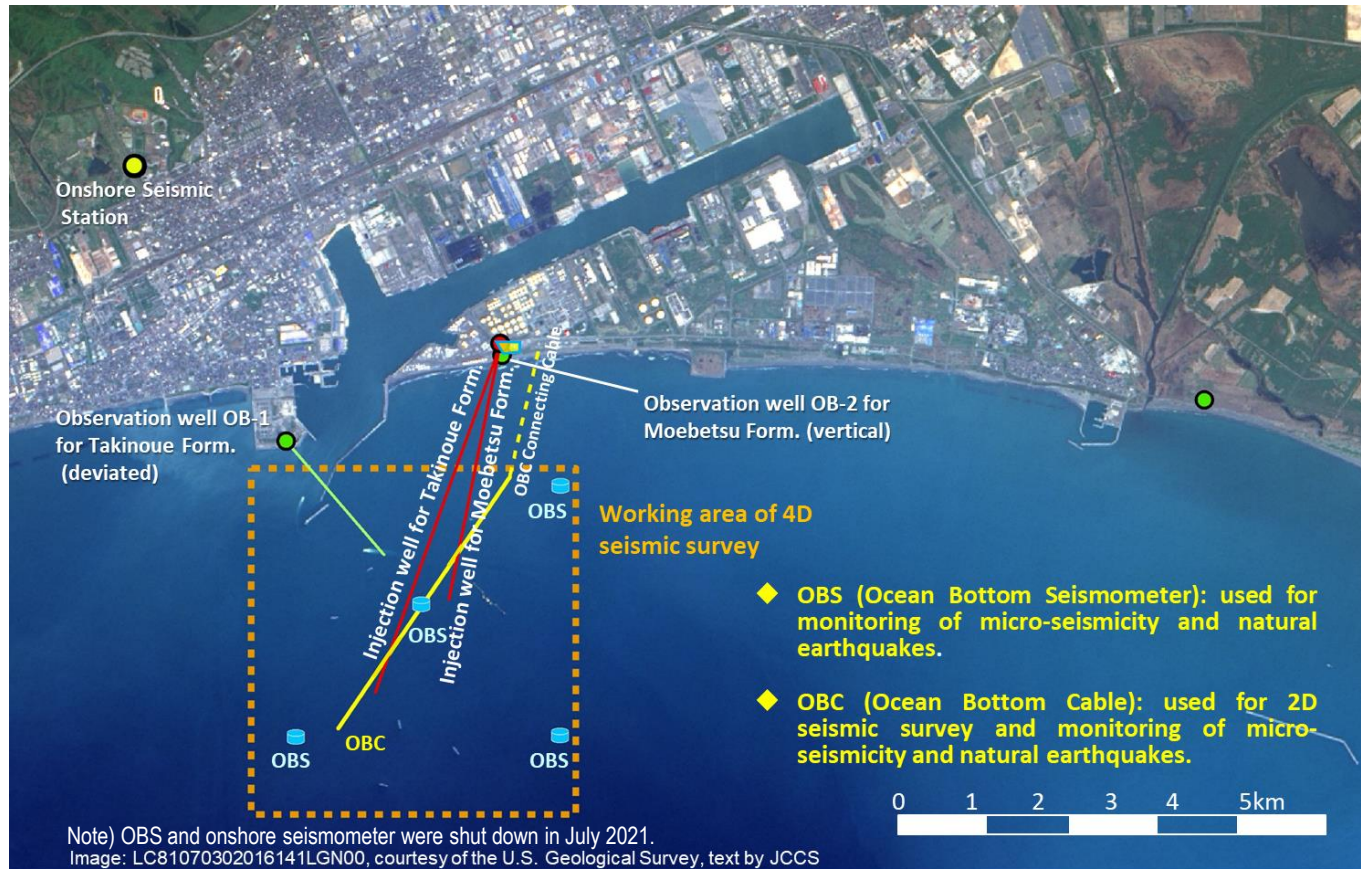
## Injection Amount in November 2019

|              | Injection Amount/month<br>(November 2019) | Cumulative CO <sub>2</sub> Injection Amount<br>(As of November 22) |
|--------------|-------------------------------------------|--------------------------------------------------------------------|
| Moebetsu Fm. | 10,793.5 tonnes                           | 300,012.2 tonnes                                                   |
| Takinoue Fm. | 0.0 tonnes                                | 98.2 tonnes                                                        |

## Change of cumulative CO<sub>2</sub> Injection Amount



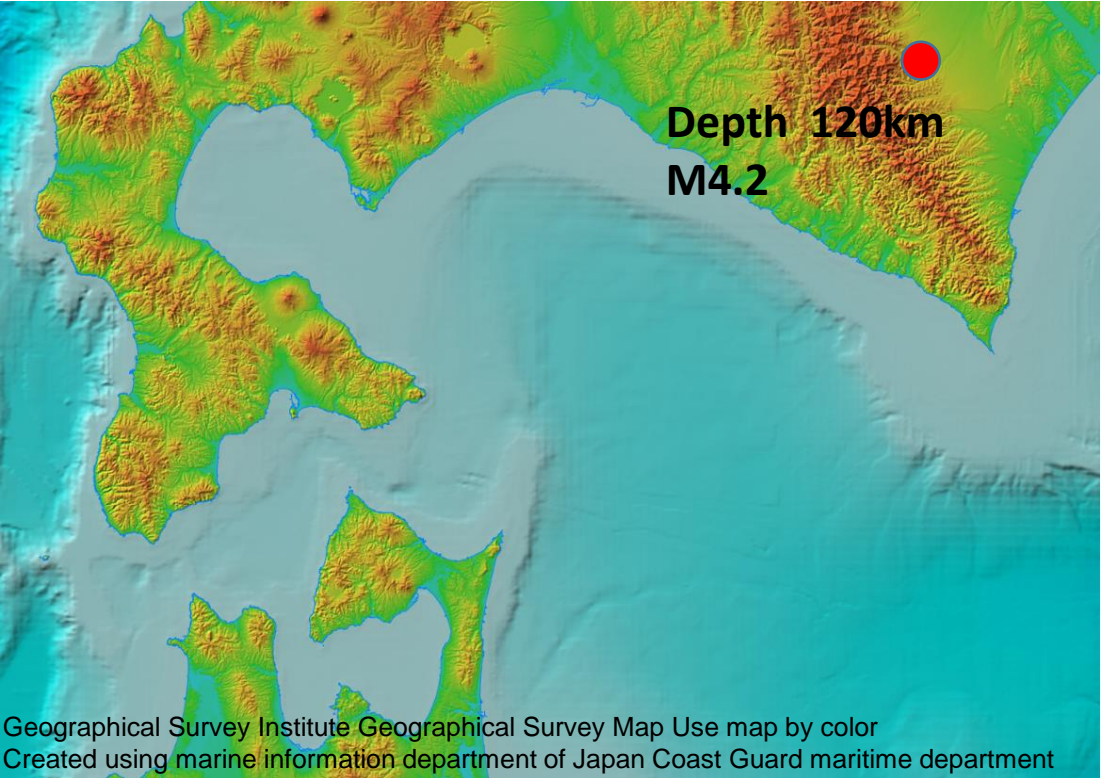
# Layout of Monitoring Network



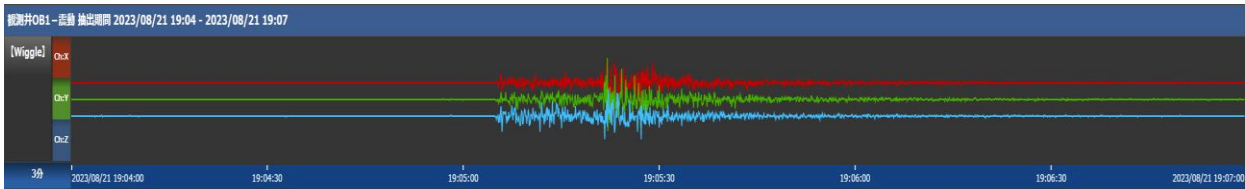
- A monitoring network was constructed near and around the CO<sub>2</sub> injection point, and continuous monitoring over six years comprising before CO<sub>2</sub> injection (1 year), during CO<sub>2</sub> injection (3 years) and after termination of injection is being carried out.
  - The formation pressures and temperatures of the wells - observation wells (3 wells) drilled around the CO<sub>2</sub> injection point and CO<sub>2</sub> injection wells (2 wells) are being monitored.
  - Seismometers were installed in the observation well and on the seabed to monitor earthquakes (including micro-seismicity - minute tremors that cannot be felt by humans).
  - Observed data is controlled centrally at the Tomakomai Demonstration Center and constant monitoring for the presence of abnormal conditions is carried out.



# The most recent noticeable tremors observed in Tomakomai



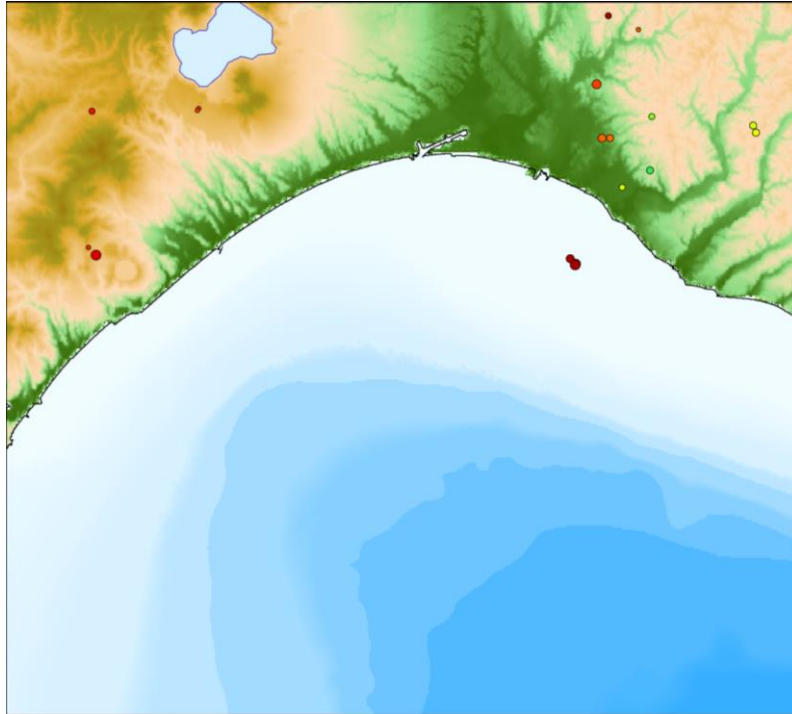
## Observation record of Seismometer in Observation Well



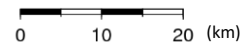
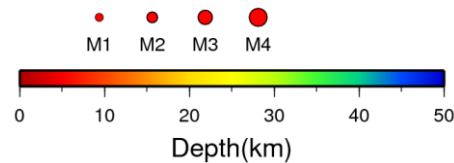
| Earthquake Information<br>Announced by the Japan Meteorological Agency |                          |
|------------------------------------------------------------------------|--------------------------|
| Time & Date                                                            | 19:04 (JST) 21 Aug, 2023 |
| Hypocenter                                                             | Lat. 42° 42'N            |
|                                                                        | Lon. 143° 0'E            |
|                                                                        | Depth 120km              |
| Magnitude                                                              | 4.2                      |
| Seismic Intensity at Tomakomai-city                                    | 1                        |



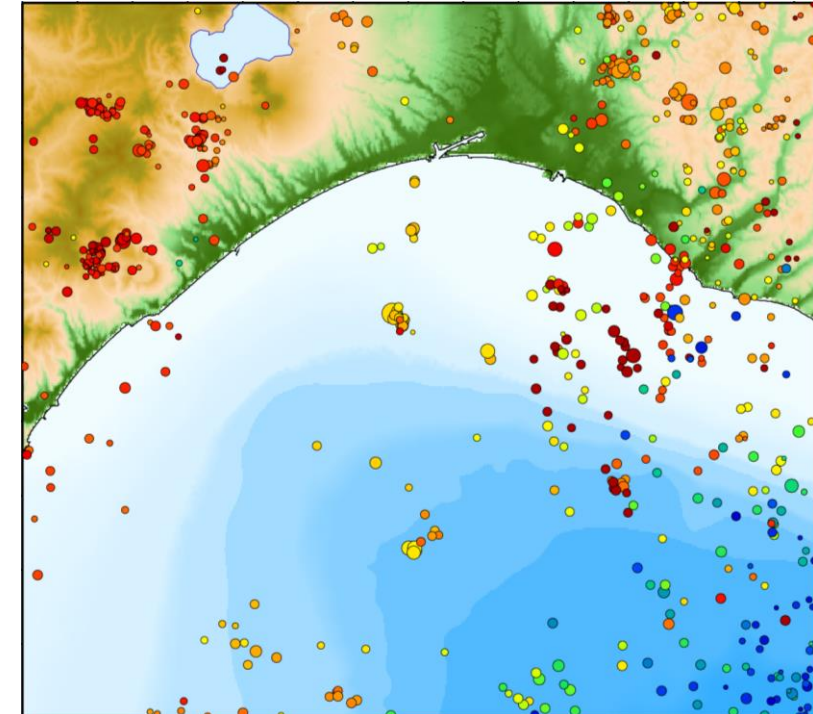
# Distribution of Natural Earthquakes around Tomakomai



Natural earthquake hypocenter distribution in Aug 2023



Geomorphic map is prepared from Geographical Survey Institute numerical map 250 m mesh (altitude) and Japan Marine Safety Agency 'Japan Oceanographic Data Center' 500 m mesh water depth data

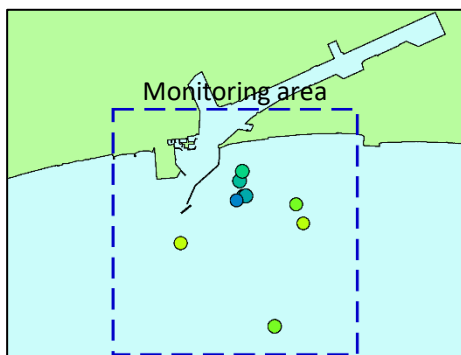


Natural earthquake hypocenter distribution occurred from 2001 to 2010

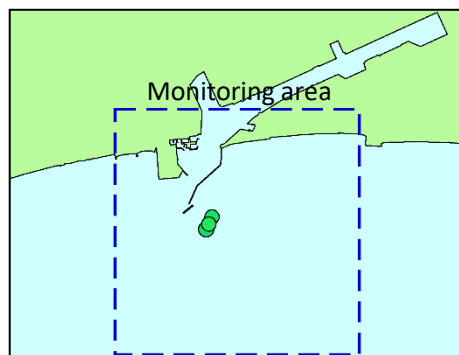
The hypocenters in the figure is from the JMA Unified Hypocenter Catalog.  
Earthquakes with the hypocenter depth of 50 km or less are displayed.

# Micro-seismic events nearby injection point

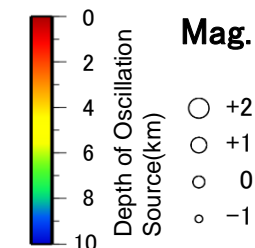
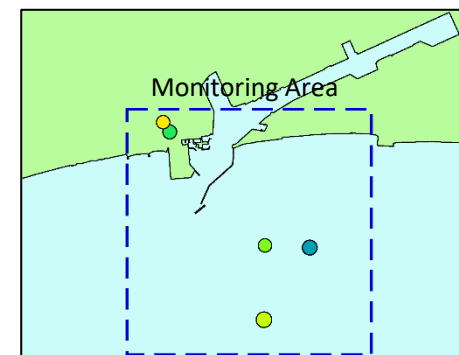
Pre-injection events (2015/2/1-2016/4/5)



Events during CO<sub>2</sub> injection (2016/4/6-2019/11/22)

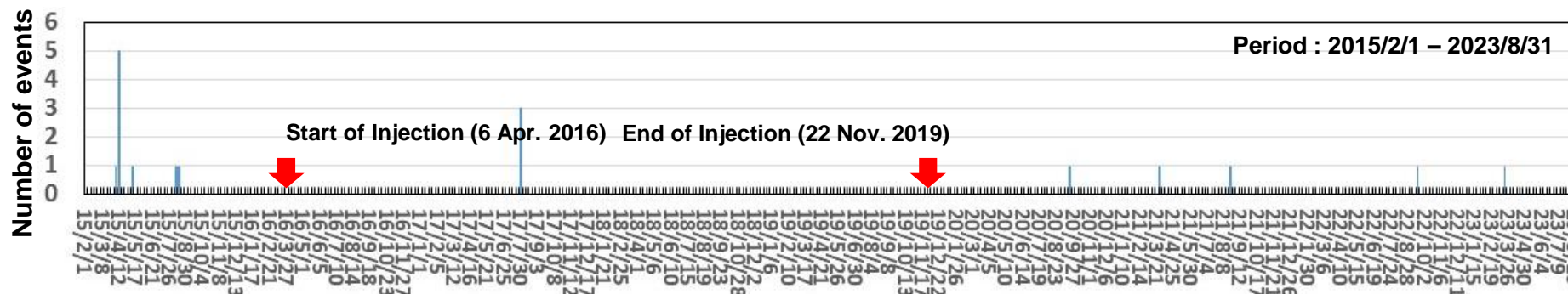


Post-injection events (2019/11/23-2023/8/31)



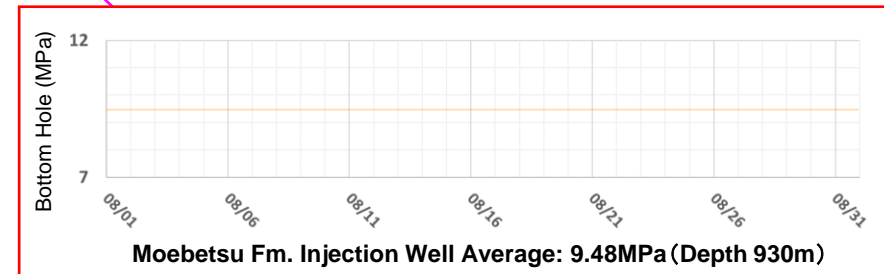
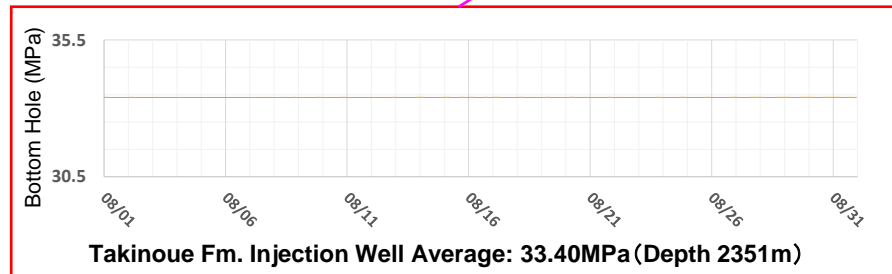
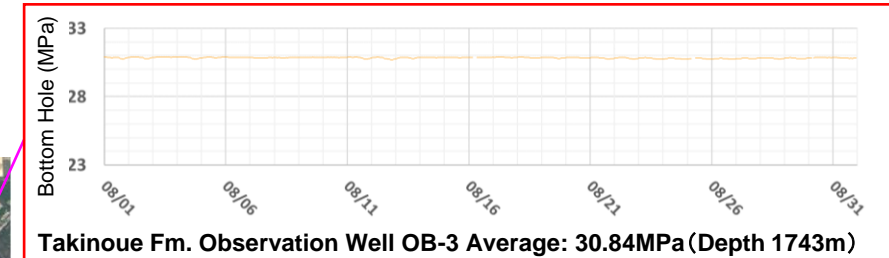
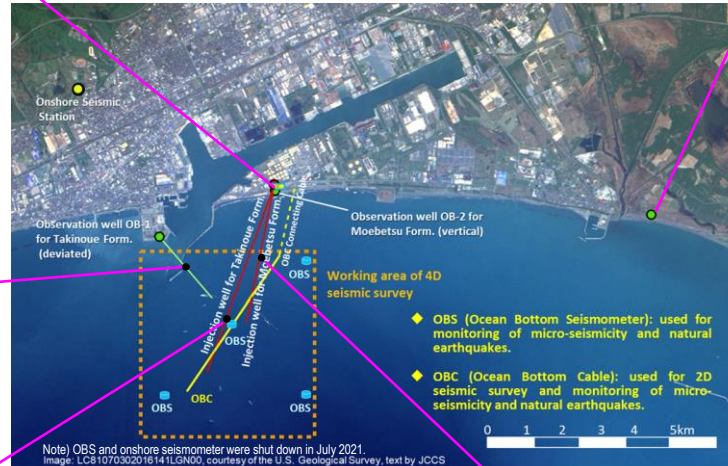
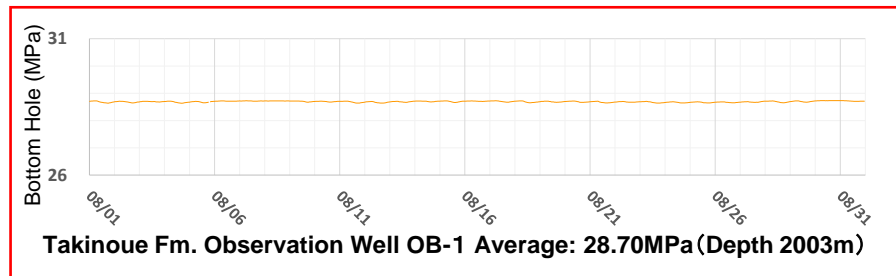
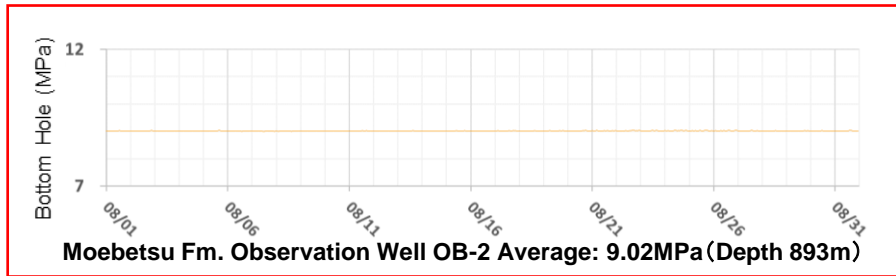
The left map is created based on the base map Information coastline data of Geospatial Information Authority of Japan.

Detection of micro-seismic events (weekly)



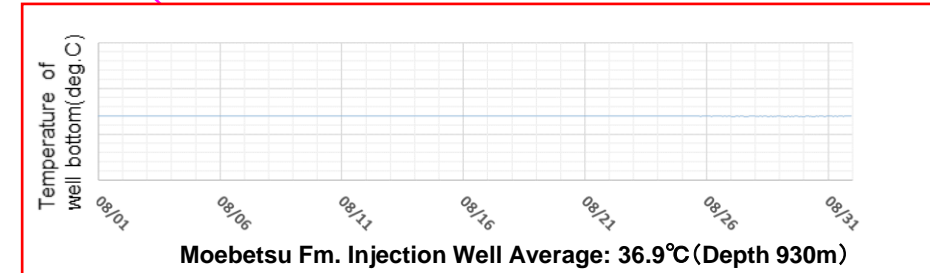
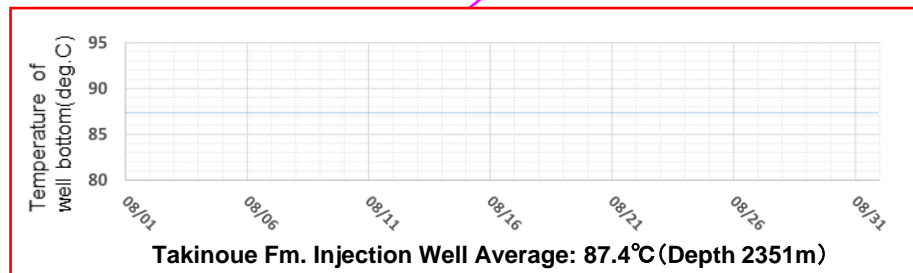
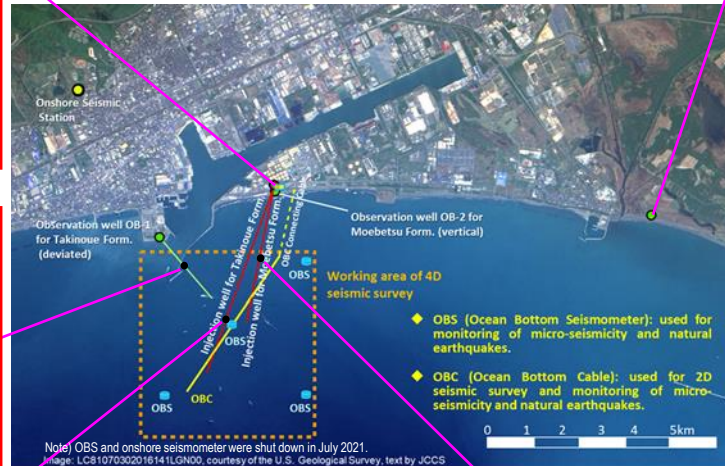
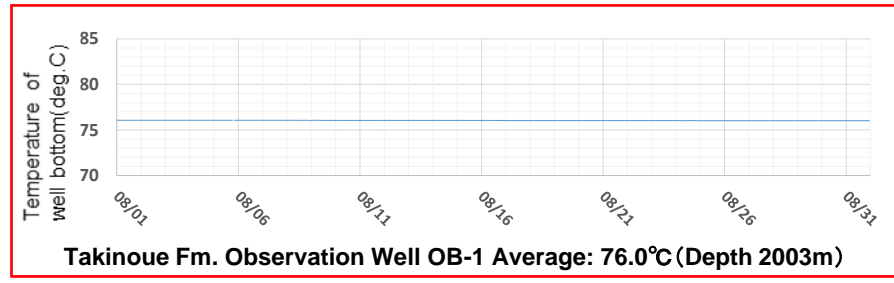
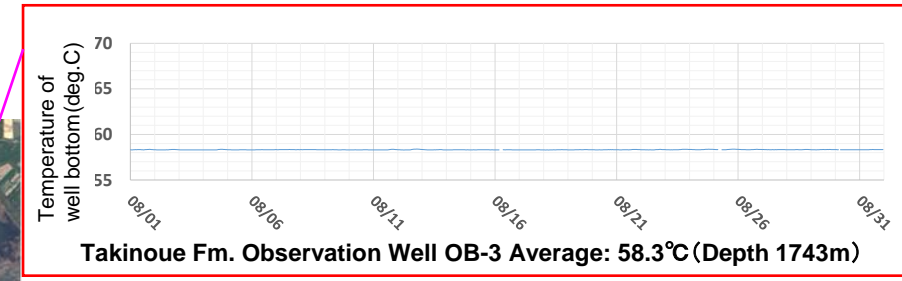
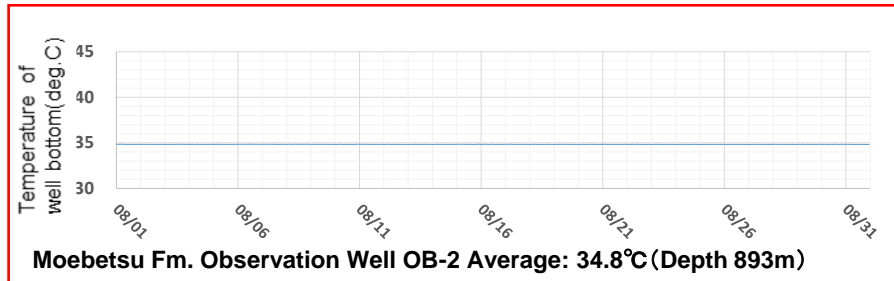
- There are perceptible earthquakes that can be felt, and imperceptible earthquakes that cannot be felt even though there are actual vibrations.
- In this project, particularly small (less than magnitude 1) imperceptible earthquakes are defined as micro-seismicity.
- In this project, micro-seismicity with a magnitude of -0.5 or more with a depth of less than 50 km in the vicinity of the injection point are monitored, due to restrictions on the placement of observation points, and constraints on seismograph detection capability, etc.

# Observation of pressure in the wells (Aug 2023)

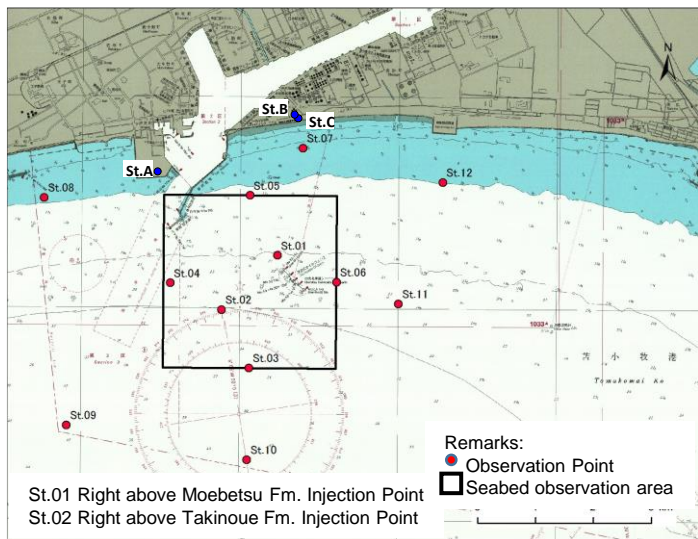




# Observation of temperature in the wells (Aug 2023)



# CO<sub>2</sub> Concentration around injection point (seasonal)



Cruise to the Japan Coast Guard issue navigation chart (W1034)

Seasonal observation of CO<sub>2</sub> concentration is conducted at three onshore points (St.A to C) and 12 offshore points (St.01 to 12). The concentration of CO<sub>2</sub> is indicated as Volume ratio (unit: volppm) at the onshore observation points, and as partial pressure (unit:  $\mu$  atm) at the offshore points. The figures of the offshore points are based on the measurement at 2 meters above the seabed.

