

2010**Environmental DNA**

Schmidt et al. first reported environmental genomics by isolating and cloning environment DNA

2005 ★**NGS sequencer**

First NGS sequencer released by Roche 454. Metagenomic study of human gut virome

1998**Metagenome**

Handersman proposed the terms metagenomics

1991**EMP project**

The Earth Microbiome Project (EMP) is an initiative founded

2024+**More expectations +****2011 ★****PacBio RS sequencer**

PacBio RS sequencer was released, read length beyond 10 kb

2014**PacBio metagenome project**

Wichmann et al. were the first to report the Exploring ARGs in dairy cow manure with PacBio RS sequencer

2014 ★**ONT MinION sequencer**

ONT released the MinION sequencer

2015**ONT metagenome project**

Greninger et al. were the first to report the utilization of real-time metagenomic detection for identifying viral pathogens in clinical specimens via MinION sequencing technology

2015**PacBio Sequel sequencer**

PacBio releases Sequel system, enhancing long-read metagenomic studies

2019**ONT Flongle, PromethION sequencer**

ONT released Flongle (small-scale sequencing applications) and PromethION (high throughput long-read sequencing). The R9.4.1 flowcell achieved average accuracy of 92%

★2022 ONT R10.4.1 Flowcell**★2014 ONT**

1998

1991

2010

2019

2024

Big deals in metagenome studies**2020****metaFlye assembler**

The long-read metagenomic assembly software "metaFlye" was published in Nature Methods

2022**PacBio Revio sequencer hifiasm-meta assembler**

PacBio Revio upgrade increases throughput and guarantees that HiFi reads attain an accuracy surpass Q30. Then "hifiasm-meta" was published in Nature Methods

2024**CycloneSEQ in Metagenomics**

The latest Chinese nanopore sequencer, CycloneSEQ, applied to metagenomic sequencing

2024**BASALT Long-read binners**

BASALT (Binning Across a Series of Assembly Toolkit) released, which can binning and optimize short- or long-read metagenomic

2023**metaSVs tool**

metaSVs (A pipeline combining long- and short-read to analyze structural variants in metagenomes) released

2023**Long-read metagenomics —a new milestone**

Comment "Long-read metagenomics paves the way toward a complete microbial tree of life" was published in Nature Methods

2022 ★**ONT R10.4.1 Flowcell Q20 chemistry**

Nanopore released Q20 chemistry and R10.4.1 flowcell. Long-read only metagenomics allows high quality genome reconstruction without Illumina correction