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Особенности потоков метана в западной и восточной Арктике
Обзор. Часть I

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Резюме Abstract PDF

В статье приведен обзор современного состояния исследований содержания метана и его выхода в атмосферу в Арктическом регионе. Представлены различные источники метана, и рассмотрены немногие существующие данные о его происхождении. Поток парникового газа метана из окраинных арктических морей играет значительную климатическую, геополитическую и социальную роль и остается одной из наиболее обсуждаемых тем в науках об океане. Арктика является наиболее чувствительным индикатором регулярных (эволюционных) процессов изменений климата. В настоящее время арктические моря представляют угрозу глобальной экологической катастрофы из-за эмиссии метана вследствие глобального потепления и таяния вечной мерзлоты. В Арктике сосредоточены огромные запасы углерода. В вечной мерзлоте на континенте и под водой содержится большое количество органического вещества, которое подвержено процессам разложения до газов CO_2 и CH_4. Существенный вклад в содержание углерода вносит речной сток. Важными источниками метана являются ископаемые углеводороды, включая уголь, нефть, газ, газогидраты, запасы которых, вероятно, огромны. Рассмотрены различные пути поступления метана в окружающую среду, механизмы вертикальной и горизонтальной миграции. По литературным данным, в Арктике возможно выделение CH_4 в атмосферу в диапазоне 32–112 Tg(CH_4) год$^{-1}$, преимущественно благодаря большому количеству болот в регионе. Недавняя оценка позволила выявить в Арктическом регионе тысячи гигатонн (1 Гт = 10^{15} г) накопленного углерода, включая неразведанные залежи метана в вечной мерзлоте и газогидратах.

Очевидно, что существующие оценки метановых источников и путей его переноса в осадках и толще вод Арктического региона характеризуются крайней неоднозначностью, обусловленной сложностью генезиса природного газа и механизмов его миграции (рассеяния, фильтрации, пузырькового переноса). Хотя выход CH_4 в океан и атмосферу является предметом обсуждений, регион мало исследован. Вечная мерзлота недостаточно изучена из-за отсутствия прямых наблюдений. Из-за недостатка данных и большого количества неопределенностей в настоящем невозможно предсказать изменения в эмиссии метана в Арктике. Объективная оценка структуры распределения и динамики окисления метана в отложениях и водной толще в арктических морях требует дальнейших исследований, основанных на изучении региона в комплексных морских экспедициях, дистанционном зондировании и организации станций газового мониторинга на суше. Авторы исследуют поток метана и ведут поиск ресурсов в Арктике с 1976 г. Представленное в статье направление является одной из важных целей для будущих исследований в Арктике в связи с грядущим председательствованием Российской Федерации в Международном Арктическом совете (экологический форум на высоком уровне) в 2021–2023 гг.

Ключевые слова

метан, изменения климата, газогидраты, вечная мерзлота, микробный оборот метана, сейсмотектонические зоны проницаемости, эмиссия метана, арктические моря

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