SNAP CODE: **110900**

SOURCE ACTIVITY TITLE: **OTHER SOURCES AND SINKS**
Gas Seeps

NOSE CODE: **310.09.01**

NFR CODE: **N/A**

1 ACTIVITIES INCLUDED

Natural gas as a product of microbial degradation derives from a variety of geological periods and therefore is stored under very different conditions in the earth's crust. While the very old storage chambers tend to be very well sealed (otherwise they would have been emptied in the time since formation), seeping of natural gas may occur at storage sites of more recent times, like from the glaciation periods. Several of such gas seeping sites have been observed, most easily under water when methane bubbles rise from a lake or the sea floor.

Gas seeps from natural gas reservoirs can not easily be distinguished from gas being developed from organic material buried in the sediment. However differentiation should be made to methane production in soils, which is described in the "wetlands" chapter (proposed SNAP 1105). The difference between these two sources of freshly produced methane is primarily in the age of the organic material to be processed, which may be thousands of years old in the first case, but is fresh material (also with respect of ^{14}C content) in the latter case. Also, the amount of material can be assessed from vegetation density in the latter case.

2 CONTRIBUTIONS TO TOTAL EMISSIONS

Due to the irregular emission patterns, only rough estimations are possible. A compilation of reports on gas seepages indicates that globally emissions may be between 8 and 65 Tg CH_4 per year [1] (approx. 2-13 % of global annual CH_4 emissions).

This activity is not believed to be a significant source of $PM_{2.5}$ (as of December 2006).

3 GENERAL

3.1 Description

Gas seeps from natural gas reservoirs or from reservoirs of organic matter occur both under shallow sea surfaces as well as at land surfaces. However only seeps under water are easily identified due to formation of gas bubbles.

Natural gas reservoirs may start seeping gas after seismic activities (earthquakes) or also depending on the outside temperature. Emissions depend on the emission rate and the size of the seep area. While a number of gas seeps have been observed, in general they seem to be highly limited in extent.

In order to be able to quantify emissions from this source, steady flow and homogeneous composition of the seeps need to be assumed. This is however not the real situation. In fact, outbursts of activity have been observed that indicate some methane formation is still active and the reservoirs are being emptied periodically. This would indicate that maximum observed emission rates should not be considered typical [2].
Submarine emissions may occur also from the deep ocean. Here only seeps from the continental shelves are considered, as most of deep ocean emissions will be dissolved in sea water long before reaching the surface.

3.2 Definitions

3.3 Techniques

Emissions from underground gas storage would be expected to be steady flow. Observed gas flow however is strongly variable, in some instances taking place primarily during summer and fall, and preferably during low tide [3]. In these cases, methane is assumed to be produced by on-going processes from buried organic material. ^{14}C depletion in the resulting methane emission proves that this material is from fossil origin [1]. In addition to bacterial production, thermogenic production is assumed, with the associated emissions being accompanied by oil seeps.

While gas formation, especially for bacterial production, may depend on the ambient temperature and decrease considerably during wintertime, gas release may also depend on other parameters. High pressure (as at high tide) or a low degree of filling of the underground storage (after a previous outburst) may halt emissions for some time.

3.4 Emissions

Natural gas emissions are primarily methane (CH_4), but at a lower rate also other alkanes may be released.

3.5 Controls

There is no control to natural emissions by definition.

4 SIMPLER METHODOLOGY

Size and location of seeping areas need to be obtained from geological offices, research institutions or petrol companies. The emissions are then calculated for each of these areas separately by:

$$E = F \times A$$

A is the area in m^2, F the average flux per m^2 (see section 8).

5 DETAILED METHODOLOGY

There is no state-of-the-art methodology.

6 RELEVANT ACTIVITY STATISTICS

There are no statistical data available. The activity (number and size of fields where seeping is taking place) may be obtained from research institutions, geological offices, or petrol companies.

7 POINT SOURCE CRITERIA

No point sources.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

As indicated earlier, emission factors are highly uncertain due to the irregularity of the emissions taking place. Emission rates of 10 l/h from one single seep hole have been reported near the California South Coast [4], but also the area-based value of 1 l/h/m^2 in the Danish coastal waters [5]. These values need to be considered absolute maxima, with typical values at least a factor of 20 lower [1, 3].

According to a compilation of all known source areas [1], the highest overall seepage rate is given for the California South Coast (Santa Barbara Channel) at 400 g/yr/m^2. As a typical emission factor, the numbers given for the Gulf of Mexico, the North Carolina coast and the Danish Kattegat and Skagerrak should be used: 50 g/yr/m^2. These factors refer to active areas only. Whenever available local information should be used however, as this number can only give a rough guidance for orientation.

For those emissions taking place at larger depths, the dissolution of methane in sea water from rising gas bubbles needs to be considered. This uptake has been discussed in more detail [1] with respect to bubble size. As a first guideline, it may be assumed that only 50 % of the emissions at 100 m depth will reach the surface.

9 SPECIES PROFILES

A typical profile for gas seeps is suggested in [4], at 75 % methane, 7 % each propane and n-butane and 6 % ethane (by weight).

10 UNCERTAINTY ESTIMATES

The uncertainty with the emission factors is assumed to be in the range of at least one order of magnitude, data quality E.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

More information on activity rates have to be obtained. Especially flux measurements are needed in areas where these emissions are known to take place. Ambient methane concentrations near potential emission areas should be observed for a prolonged period of time in order to determine duration and strength of possible active and quiet periods.

12 SPATIAL DISSAGGREGATION CRITERIA FOR AREA SOURCES

Even distribution within each field.

13 TEMPORAL DISSAGGREGATION CRITERIA

Constant emission flux is assumed, as otherwise temporal disaggregation would have to be based on observations, event based.

14 ADDITIONAL COMMENTS

Natural gas seeps are not at all influenced by humans.

15 SUPPLEMENTARY DOCUMENTS

16 VERIFICATION PROCEDURES

17 REFERENCES

[1] Hovland M., Judd A.G., Burke R.A. (1993). The global flux of methane from shallow submarine sediments. Chemosphere 26, 559-578.

[2] Iversen N. (1997). Aalborg University, DK, personal information.

[3] Martens C.S., Klump J.V. (1980), Biogeochemical cycling in a organic-rich coastal marine basin. 1. Methane sediment-water exchange processes. Geochim. Cosmochim. Acta 44, 471-490.

[4] Radian Corporation (1996). EIIP Volume 5, biogenic sources preferred methods. Final report to the Area Sources Committee, Emission Inventory Improvement Program, May 1996.

[5] Fenger J., Fenhann J., Kilde N. (1990). Danish budget for greenhouse gases. Nord 1990:97, Nordic council of ministers, Copenhagen, 1990.

18 BIBLIOGRAPHY

19 RELEASE VERSION, DATE AND SOURCE

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Contributions from: Niels Iversen, Aalborg University, Denmark

Updated with particulate matter details by:
Mike Woodfield
AEA Technology
UK
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20 POINT OF ENQUIRY

Any comments on this chapter or enquiries should be directed to:

David Simpson

Norwegian Meteorological Institute (MSC-W)
c/o IVL, PO Box 47086
Dagjamningsgatan 1
S-402 Goteborg
Sweden

Tel: +46 31 7256214
Fax: +46 31 7256290
Email: david.simpson@ivl.se