



Selected References on Saline Ground-Water Resources of the United States

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By J. H. Feth



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*Cites references to occurrence and geochemistry of saline ground water, including
oil-field brines, and to problems of sea-water intrusion into aquifers*

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INTRODUCTION

PURPOSE OF THE REPORT

Requirements for more and more water pose well-known problems in many parts of the United States. Industry has turned to saline water to meet some of its requirements, especially to meet cooling-water and process-water needs in areas where saline water is obtainable readily and where the used water can be disposed of without damage to adjacent supplies of fresh water.

Locally, water is being desalinated for municipal systems and military installations and for boiler feed or other industrial uses. The Office of Saline Water of the U.S. Department of the Interior, various State agencies, universities, and commercial establishments support research into means of desalinating water at costs small enough to make the product competitive with naturally fresh water.

Except in coastal areas or near saline lakes, the only large supplies of saline water are underground.

The growing interest in saline water therefore indicates a need for greater understanding of its occurrence underground. The amounts available and their geologic habitat, chemical characteristics, and relations to supplies of fresh ground water are factors of increasing interest. This report, a list of selected references and cross indexes, is designed to introduce readers to the existing literature on saline ground water. It is intended to serve as an aid to further investigations. The list of references is by no

means exhaustive, but it is representative of the types of information available and will serve to lead the reader into the literature.

WHAT IS "SALINE" GROUND WATER?

There is no generally accepted definition of "saline." The U.S. Public Health Service (1962, p. 33) recommends that public water supplies should not contain more than 500 ppm (parts per million) of dissolved solids where acceptable supplies of lesser concentration are available. The Public Health Service recognizes, however, that more than 100 public-supply systems in the United States deliver water having a dissolved-solids content of more than 2,000 ppm. In an earlier report (U.S. Public Health Service, 1946), concentrations of 1,000 ppm were acceptable for use in interstate carriers where water of lower mineral content was not available.

The U.S. Geological Survey has used 1,000 ppm dissolved solids as a lower limit for water defined as "saline," although this practice has met with some objection (see Kreiger, 1963, and discussion by Davis). For drinking water, the type of mineralization rather than the absolute concentration frequently determines whether or not the water is satisfactory.

It seems infeasible to develop a new definition that will satisfy everyone and every need. On the other hand, the Office of Saline Water and many other agencies evidently work from the premise that domestic supplies having 1,000 ppm dissolved solids, or less, are desirable. Limited experience gained from installations now operating suggests that desalination plants producing water for domestic use reduce mineral content to less

than 1,000 ppm. For the purposes of the present bibliography, then, 1,000 ppm is accepted as the "saline-water" cutoff, with the recognition that the limit is arbitrary and is exceeded in daily use throughout large areas of the United States as well as in many other parts of the world.

SCOPE OF THE REPORT

The references cited are completed, published reports almost exclusively. Abstracts are omitted. Reports that were circulated to only a few places—such as open-file reports of the U.S. Geological Survey and mimeographed or dittoed reports from various sources—were omitted, with a few important exceptions. Reports on industrial use of saline ground water and reports of research and problems related to desalination are not included. The references also do not include publications dealing primarily with contamination of fresh-water aquifers by industrial or agricultural wastes. Emphasis is placed on naturally occurring saline ground waters, as well as on sea-water encroachment.

The bibliography includes only publications dealing with saline ground water in the United States, and only to English-language publications. Reports on saline water in surface supplies are not included.

References cited are listed in alphabetical order by authors' names. The citations follow standard practices for publications of the U.S. Geological Survey. Full titles of abbreviated serial publications can be found in U.S. Geological Survey Bulletin 1196 and in other volumes of the "Bibliography of North American Geology" series published by the U.S. Geological Survey.

Indexes relate to subject-matter categories as follows:

General references.—Studies of areas as large as or larger than a single State; definitions of "saline"; theories of how brines become more concentrated than the sea water from which they are believed to have formed.

Oil-field brines.—A few decades ago much attention was given to attempts to use the chemical characteristics of saline water as guides to the presence of petroleum or natural gas. References are a sample of the rather extensive literature that resulted.

Sea-water encroachment.—Fresh-water aquifers in coastal areas commonly have connection with the sea. References deal with the theory of sea water-fresh water interfaces and with localities where sea-water encroachment has occurred or threatens to occur.

Areal studies (States).—Reports deal with ground-water conditions in areas ranging from a few square miles to a few thousand square miles where saline ground water presents problems or where six or more analyses of water show dissolved-solids content of 1,000 ppm or more, or both. These studies are indexed by States along with references repeated from other categories that deal wholly or mainly with conditions in one State.

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