The Environmental and Health Concerns Associated with Fluoride in Drinking Water

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Outline

1. Debate on benefits and risks of fluoride
2. Extent of water fluoridation practices
3. Naturally occurring fluoride
4. Anthropogenic sources of fluoride
5. Known health effects of high F concentration
6. Unknown environmental and health effects of F in warm climates
7. Proposed cooperation on F studies and its control

Introduction

- Pros and cons – debate goes on the benefits and risks of fluoride
- Summary of literature search – by countries and topics
- Our research on F removal from semiconductor wastewater

Summary of references by source

Region/Source	Number of articles	Percentage
Asia	30	12.4
Australia-New Zealand	16	6.6
Canada-USA	58	24.0
Europe	50	20.6
Latin America-Africa	16	6.6
Lancet	25	10.3
Fluoride	20	8.3
International Orgs	22	9.1
Major Reports	5	2.1
TOTAL	**242**	**100**

Fluoride intake

- **The WHO water quality guideline value is 1 mg/L to provide protection against dental caries.**
- **Other sources of F intake are fluoridated salt, milk, sugar, toothpastes, varnishes, rinses, and supplements**

Presence of Natural Fluoride

- **Waters high in fluoride are found mostly in calcium deficient ground waters, in geothermal waters and in some sedimentary basins**

Phosphate Fertilizer & Water Fluoridation

- Phosphate rock has an estimated 2 to 4% of fluoride. Phosphate fertilizers are produced by adding acid to pulverized phosphate rock - either sulfuric or phosphoric acid. Significant quantities of fluoride (hydrogen fluoride and silicon tetrafluoride) are released but captured in the pollution control "scrubbers.“

- Hydrofluorosilicic acid is the waste product from the "scrubbers" that is used to fluoridate approximately 90% of US public drinking water systems.

Monitoring of F

- In drinking water, monitoring of fluoride concentration requires specific laboratory equipment and skilled personnel since there is a narrow range at low levels (0.7-1.5 mg/L) which can spell the difference between beneficial and adverse health effects.
- This may not be possible in many developing nations.

Extent of water fluoridation practices

- Several countries practiced water fluoridation in the last 50 years with remarkable improvement in oral health.
- Water fluoridation is practiced mainly in English speaking countries

Water Fluoridation Practices

Percentage of population using fluoridated water

- USA – 67%
- UK – 10%
- Singapore – 100%
- Australia, Brazil, Canada, Ireland, Israel, Malaysia, New Zealand, South Africa

http://www.epa.gov/ogwdw/hfacts.html

Inorganic Contaminants - USEPA

- **Fluoride. Many communities add fluoride to their drinking water to promote dental health. Each community makes its own decision about whether or not to add fluoride. EPA has set an enforceable drinking water standard for fluoride of 4 mg/L (some people who drink water containing fluoride in excess of this level over many years could get bone disease, including pain and tenderness of the bones).**

http://www.epa.gov/ogwdw/hfacts.html

Inorganic Contaminants - USEPA

- **EPA has also set a secondary fluoride standard of 2 mg/L to protect against dental fluorosis. Dental fluorosis, in its moderate or severe forms, may result in a brown staining and/or pitting of the permanent teeth. This problem occurs only in developing teeth, before they erupt from the gums. Children under nine (9) years old should not drink water that has more than 2 mg/L of fluoride**

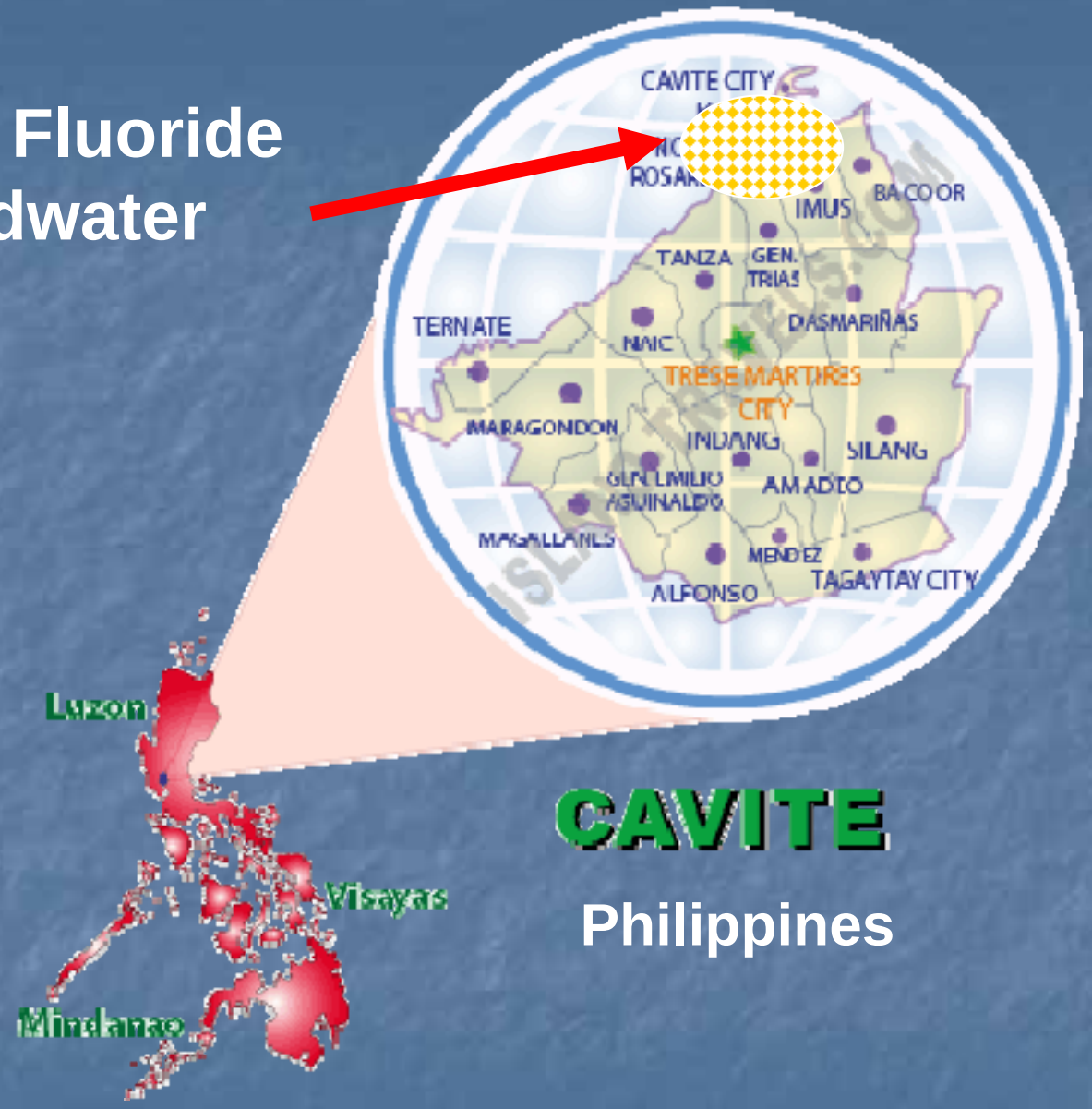
Naturally occurring fluoride

- Countries with natural sources of elevated fluoride in groundwater –
- Most notable are China, India, Pakistan and Mongolia but growing evidence in other Asian countries

Philippines

- Elevated level of flouride in groundwater was found in the coastal areas of Cavite City, Noveleta, Bacoor and Kawit
- Cavite City, Philippines is 34 Km south of Manila

Elevated Fluoride in groundwater



CAVITE

Philippines

Anthropogenic sources of F

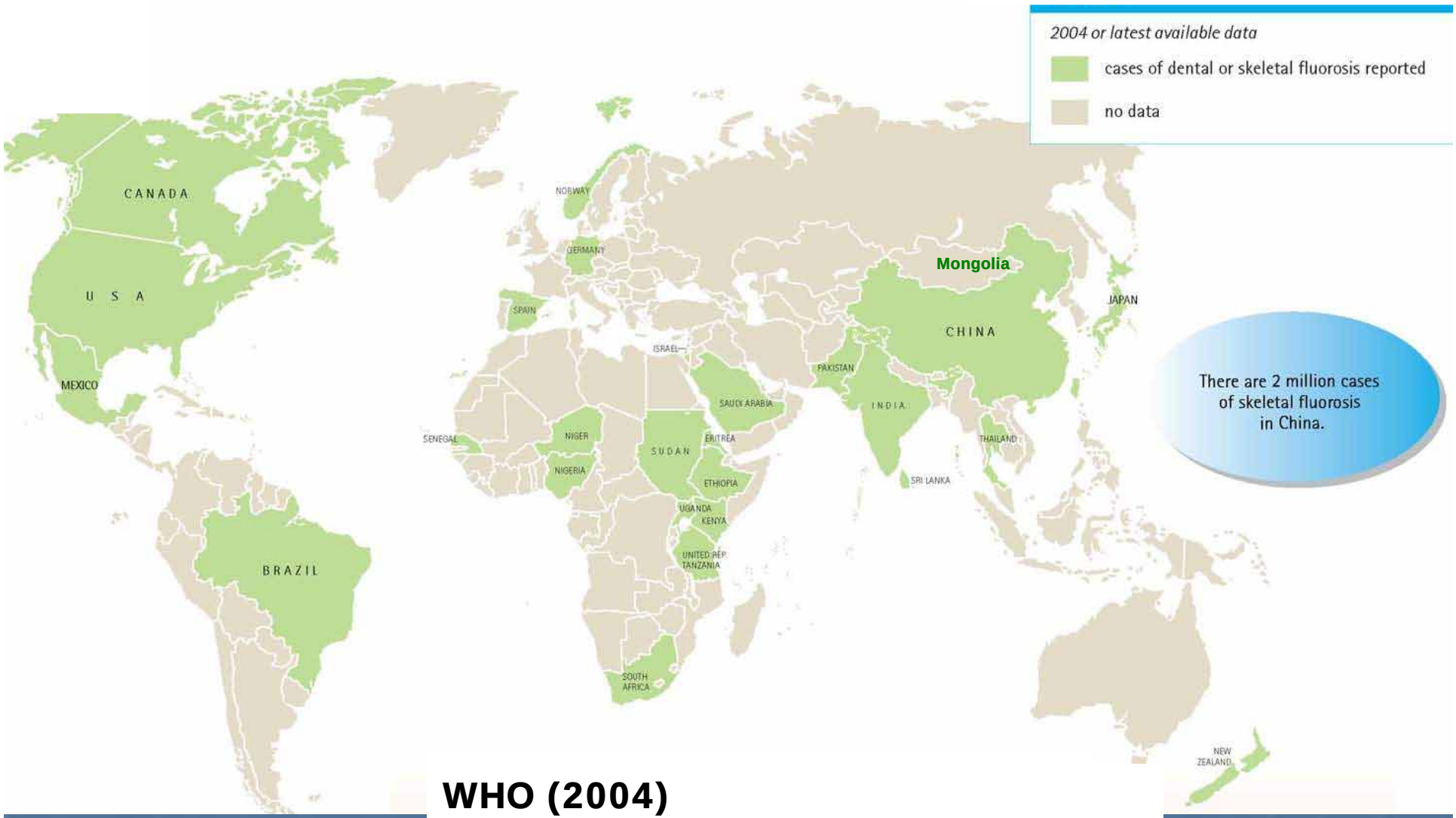
- Fluoride is found in insecticides, rodenticides, floor polishes, petroleum and aluminum industries, coal burning, glass etching and timber preservation, tea

- Hydrogen fluoride / hydrofluoric acid is used in the semiconductor industry, the manufacture of chemicals, solvents and plastics, and in laundries.

Known health effects of high F concentration

- Elevated fluoride concentration in water has been associated with dental and skeletal fluorosis, severe enamel fluorosis, osteosarcoma (bone cancer), osteoporosis and neurological effects
- More symptoms - increased bone fractures, Down syndrome and reproductive effects (WHO/IPCS 2002).

Skeletal/dental fluorosis global map 2004



WHO (2004)

Unknown environmental and health effects of F in warm climates

- Less is known on its biomagnification and bioavailability to aquatic and terrestrial biota and its sublethal effects in warmer climates.
- This has implications on increased F toxicity especially to humans.

Biosynthesis of organofluorides

- Many inorganic contaminants may be transformed into substances more toxic than the pollutants in their original form, e.g. mercury.
- Reports claim that some plants can synthesize organic fluoride compounds (fluoroacetate and fluorocitrate) from inorganic fluorides.
- Both are very toxic.

Proposed cooperation on F studies and its control

- More studies are needed to know the behavior and distribution of F in various environmental media – to track its environmental pathway including its transformation
- Water fluoridation should be seriously evaluated if the benefits far outweigh the risks

Proposed cooperation on F studies and its control

(a) The temperature effect on fluoride toxicity in freshwater aquatic environment,

(b) The increase in dental fluorosis among children in warmer climates than in temperate climates,

(c) Elevated background fluoride concentrations in soil and water from natural and man made sources, and

(d) Fluoride concentration global map

(e) Fluoride removal technologies especially in drinking water

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Thank you for your attention