Title	Author	Source	Volume	Issue	Begin Page	End Page	Publish Year	Abstract
RHENIUM IN SEAWATER - CONFIRMATION OF GENERALLY CONSERVATIVE BEHAVIOR	ANBAR, AD; CREASER, RA; PAPANASTASSIOU, DA; WASSERBURG, GJ	GEOCHIMICA ET COSMOCHIMICA ACTA	56	11	4099	4103	1992	A depth profile of the concentration of Re was measured in the Pacific Ocean using a technique we have developed for the clean chemical separation and the precise measurement of Re by isotope dilution and negative thermal ionization mass spectrometry (ID-NTIMS). This technique permits Re concentrations to be determined from 200 mL of seawater with a typical precision of +/- 5 parts per thousand. This is an improvement of at least a factor of 100 over the techniques used in previously published determinations of Re in seawater. We obtain a narrow range for Re from 7.20 +/- 0.03 to 7.38 +/- 0.03 ng/kg for depths between 45 m and 4700 m. This demonstrates that Re is relatively well mixed throughout the water column and confirms the theoretical prediction that the behavior of Re in the oceans is conservative. When examined in detail, both salinity and the concentration of Re increase by approximately 1.5% between 400 and 4700 m, a correlation consistent with conservative behavior. However, Re appears to be depleted relative to salinity by 1.0-1.5% at 100 m, and enriched by approximately 4% at the surface. These observations suggest a minor level of Re scavenging in near surface waters, and an in
Selected physical and biological data -- by element	ANONYMOUS;	Radionuclide Exposure of the Embryo /Fetus : Recommendations of the National Council on Radiation Protection and Measurements (NCRP Report No 128) %1998 Sep ;:93 -216					1998 Sep	
TRANSPORT AND DISTRIBUTION OF RE-188 IN CENTRAL NERVOUS-SYSTEM	BARDFELD, PA; SHULMAN, K	EXPERIMENTAL NEUROLOGY	50	1	1	13	1976	
General aspects of and specific data on ecological effects of metals	Beijer K;Jernelov A;			253		268	1986	Biosis copyright: Biol abs. Rrm grazing animal fish aquatic environment soil vegetation food chain ecosystem stability
The lesser metals.	Beliles R.P.	Toxicity of Heavy Metals in the Environment. Part 2. Oehme F.W.(Ed.), Marcel Dekker Inc.			547		1979	KEY STUDY DESCRIPTORS RT : Comprehensive or authoritative reviews of toxicity and metabolism. RV : Review of specific toxicological aspects (indicated by additional keys), generally without original data. TO : Toxicity, pharmacology and all other biological effects. ME : Metabolism: absorption, distribution, metabolism and excretion by living organisms. Levels in tissues and excreta, and binding (excluding DNA binding). MN : Study in humans (man). MA : Study in mammals (excluding humans). MI : Study in microorganisms (e.g. bacteria, simple algae and fungi). NO : None of these (MA, MN or MI), i.e. other species. OR : Oral route of exposure (gavage, feed or drinking water). LO : Local application (i.e. to skin or mucous membranes).. JE : Injection (or implantation) exposure (e.g. intravenous, subcutaneous or intraperitoneal). HA : Inhalation (or intratracheal) exposure. VI : In vitro studies. OC : Occupational exposure. AC : Acute exposure: single exposure or repeated exposures within 48 hours. RD : Short-term or long-term exposure (repeated dosage): generally above 2 days.
Concentrations of 63 elements in cabbage and sprouts in Denmark	Bibak A;Sturup S;Knudsen L;Gundersen V;	Communications in Soil Science and Plant Analysis	30	2409		2418	1999	Biosis copyright: Biol abs. The multi-element levels (Mug kg-1, fresh weight) In cabbages (Brassica oleracae l. Var. Capitata, scandic) And sprouts (Brassica oleracae l. Var. Gemmifera, explorer) Are presented in this paper. The cabbages and sprouts were collected from 10 background areas for each crop, on funen, in north jutland, central jutland, south east jutland, and north zealand, denmark. The crops were cultivated with intensive use of fertilizers and pesticides. High resolution inductively coupled plasma mass spectr , and barium (Ba)), The mg concentration level was higher in sprouts than in cabbage, and sr and ba showed the opposite pattern. The concentrations of boron (B), Silicon (Si), Phosphorus (P), Sulfur (S), Selenium (Se), And tellurium (Te), Were higher in sprouts than in cabbage, except for te, in which the concentration in cabbage was greater than in sprouts. Actinides (Thorium (Th) And uranium (U)) And lanthanides (Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Samarium (Sm), Eu uptaker than cabbage. The results provide
Toxicity of Sixty-Three Metals and Metalloids to Hyalella azteca at Two Levels of Water Hardness	Borgmann, U., Y. Couillard, P. Doyle, and D.G. Dixon	Environ.Toxicol.Chem.	24	3	641	652	2005	LC50 for scud, ECOTOX search
Plant Biosphere - Natural extractor and concentrator of rhenium from soils and waters	Bozhkov, O; Tzvetkova, C; Blagoeva, T	LECTURE NOTES ON ENERGY AND ENVIRONMENT			257	261	2007	The plant Biosphere was shown to be a natural biocollector and concentrator of dispersed rhenium in environment. The bioaccumulation and preconcentration of rhenium in plants can be used for its recovery from soils and waters from ore dressing and work processing regions. A new approach to the development of a procedure for rhenium phytorecovery is proposed. Regional investigations on the degree of rhenium accumulation in different kinds of plants growing in the vicinity of the ore dressing mines Asarel-Medet and copper processing Medet in Bulgaria were carried out. The results showed that the plant Biosphere in these vicinities was enriched in different but considerable amounts of rhenium, which exceeded its natural spread in Earth's crust 1400 to 44000 times. The content of rhenium. in the vegetation growing along the river exceeds its content in flowing rivers 395-times. It was shown that the concentration of rhenium in green and dry yellow leaves from the same vegetation was equal. This evidences that the dry leaves can also be used as a source for rhenium
Rapid multi-element analysis of groundwater by high-resolution inductively coupled plasma mass spectrometry	Cheng, Z; Zheng, Y; Mortlock, R; van Geen, A	ANALYTICAL AND BIOANALYTICAL CHEMISTRY	379	3	512	518	2004	A rapid and sensitive method was developed to determine, with a single dilution, the concentration of 33 major and trace elements (Na, Mg, Si, K, Ca, Li, Al, P, S, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Mo, Cd, In, Sn, Sb, Cs, Ba, Re, Hg, Pb, Bi, U) in groundwater. The method relies on high-resolution inductively coupled plasma mass spectrometry (HR ICP-MS) and works across nine orders of magnitude of concentrations. For most elements, detection limits for this method are considerably lower than methods based on quadrupole ICP-MS. Precision was within or close to +/-3% (1sigma) for all elements analyzed, with the exception of Se (+/-10%) and Al (+/-6%). The usefulness of the method is demonstrated with a set of 629 groundwater samples collected from tube wells in Bangladesh (Northeast Araiharzar). The results show that a majority of tube well samples in this area exceed the WHO guideline for As of 10 mug L-1, and that those As-safe wells frequently do not meet the guideline for Mn of 500 mug L-1 and U of 2 mug L-1.
BIOLOGICAL AVAILABILITY OF RADIONUCLIDES PRODUCED BY PLOWSHARE EVENT SCHOONER .2. RETENTION AND EXCRETION RATES IN PECCARIES AFTER A SINGLE ORAL DOSE OF DEBRIS	CHERTOK, RJ; LAKE, S	HEALTH PHYSICS	20	3	325	330	1971	
BIOLOGICAL AVAILABILITY OF RADIONUCLIDES PRODUCED BY PLOWSHARE EVENT SCHOONER .3. ACCUMULATION, EXCRETION RATES AND BODY DISTRIBUTION IN PECCARIES AFTER DAILY INGESTION OF DEBRIS	CHERTOK, RJ; LAKE, S	HEALTH PHYSICS	20	6	577	584	1971	

Rhenium and molybdenum enrichments in sediments as indicators of oxic, suboxic and sulfidic conditions of deposition	Crusius, J; Calvert, S; Pedersen, T; Sage, D	EARTH AND PLANETARY SCIENCE LETTERS	145	01-Apr	65	78	1996	The trace elements Re and Mo both behave conservatively in seawater yet are strongly enriched in reducing sediments. Their potential for authigenic enrichment above crustal concentrations is greater than for many other elements, due to the high ratio of [metal](sw)/[metal](crust). We present sedimentary Re and Mo data from box- and multi-cores spanning a range of redox conditions, from well-oxygenated sites to locations with substantial sulfide concentrations. At the oxic sites, Re and Mo, as expected, accumulate at concentrations close to their crustal abundances. Re shows substantial enrichment in suboxic (absence of O-2 and H2S) sediments of the Sea of Japan, in sediments within the oxygen minimum of the Pakistan margin, as well as in sediments underlying the sulfide-bearing waters of the Black Sea and Saanich Inlet. Re enrichment occurs in these cores just below the depths of Fe and U reduction. only in the sediments underlying the sulfidic waters of the Black Sea and Saanich Inlet is there substantial authigenic Mo accumulation Absence of
Mobility of authigenic rhenium, silver, and selenium during postdepositional oxidation in marine sediments	Crusius, J; Thomson, J	GEOCHIMICA ET COSMOCHIMICA ACTA	67	2	265	273	2003	Sedimentary records of redox-sensitive trace elements hold significant potential as indicators of paleoceanographic environmental conditions. Records of Re can reveal the intensity of past reducing conditions in sediments at the time of deposition, whereas records of Ag may record the magnitude of past diatom fluxes to the seafloor. Confidence in paleoenvironmental reconstruction from records of either metal, however, requires it to have experienced negligible redistribution since deposition. This study examines diagenetic rearrangements of Re and Ag that occur in response to exposure to bottom-water O-2 in environments of low sedimentation rate, including Madeira Abyssal Plain turbidites and eastern Mediterranean basin sapropels. Authigenic Re was remobilized quantitatively by oxidation but poorly retained by the underlying sediments. All records are consistent with previous work demonstrating that only a limited reimmobilization of Re occurs preferentially in C-org-rich, reducing sediments. Silver was also mobilized quantitatively by oxidation, but it was subsequently
Comparative behavior of authigenic Re, U, and Mo during reoxidation and subsequent long-term burial in marine sediments	Crusius, J; Thomson, J	GEOCHIMICA ET COSMOCHIMICA ACTA	64	13	2233	2242	2000	The trace element Re is enriched in mildly reducing, suboxic sediments, close to or slightly later in the redox sequence than U, and before reduction of Mo in more reducing, sulfidic sediments. This work investigates the behavior of authigenic Re during oxidation and long-term burial in the sediments of several turbidites from the Madeira Abyssal Plain. Exposure to bottom water O-2 clearly remobilizes authigenic Re, as found in previous work, but reimmobilization occurs in reducing sediments below the oxidation front over a depth range of 0.5-3 m. The large spread of the Re "burndown peak" must be kinetically controlled, perhaps influenced by the C-org content. Once reimmobilized, however, the authigenic Re signal remains immobile for at least 3.4 Myr. Authigenic U, in contrast, consistently forms peaks approximate to 0.5 m broad, whereas authigenic Mo is lost on oxidation and does not appear to be refixed unless authigenic pyrite is formed. These results imply that any paleoenvironmental significance of authigenic Re will be compromised in low sedimentation rate environments (<
Assessment of maximal tolerated dose of Re-188-perrhenate, a potential agent for treatment of NIS-expressing tumors, in a mouse model.	Dadachova, E; Russell, R; Zuckier, LS	JOURNAL OF NUCLEAR MEDICINE	43	5	120P	120P	2002	
Aquatic sediments	Davis WS;Denbow TJ;	J Water Pollut Control Fed	60	1077		1088	1988	Biosis copyright: Biol abs. Rrm review water pollution water chemistry metals radionuclides model kinetics soil pollution
PHARMACOKINETICS OF RE-186 AFTER ADMINISTRATION OF RHENIUM-186-HEDP TO PATIENTS WITH BONE METASTASES	DEKLERK, JMH; VANDIJK, A; VANHETSCHIP, AD; ZONNENBERG, BA; VANRIJK, PP	JOURNAL OF NUCLEAR MEDICINE	33	5	646	651	1992	The pharmacokinetics of Re-186-HEDP, a radiopharmaceutical for palliative treatment of metastatic bone pain, was investigated in 11 patients (17 studies) who suffered from metastatic breast or prostate cancer. Half-life times of Re-186 in three blood fractions (whole blood, plasma and plasma water) were 40.1 +/- 5.0, 41.0 +/- 6.0 and 29.5 +/- 6.4 hr, respectively. Time-dependent increase in plasma-protein binding was observed, probably caused by in vivo decomposition of Re-186-HEDP. Total urinary Re-186 excretion was 69% +/- 15%, of which 71% +/- 6% was excreted in the first 24 hr after injection. The BSI (i.e., fraction of the skeleton showing scintigraphic evidence of metastatic disease) closely correlated with the fraction of dose non-renally cleared (r = 0.98). This implies that the amount of radioactivity taken up by the skeleton and hence the bone marrow absorbed dose can be predicted from a diagnostic pre-therapy Tc-99m-HDP scintigram. The pharmacokinetic behavior indicates that Re-186-HEDP has suitable properties to justify its application.
The chemistry of rhenium and technetium as related to the use of isotopes of these elements in therapeutic and diagnostic nuclear medicine.	Deutsch, E; Libson, K; Vanderheyden, J L; Ketring, A R; Maxon, H R	Int J Rad Appl Instrum B	13	4	465	77	1986	The beta emitting isotopes 186Re and 188Re are logical choices on which to base therapeutic radiopharmaceuticals that might be expected to be analogous to diagnostic radiopharmaceuticals based on 99mTc. However, the chemistry of rhenium is sufficiently different from that of technetium so that the development of Re radiopharmaceuticals often cannot be predicated on the known chemistry and biological behavior of 99mTc radiopharmaceuticals. The relevant chemical differences involve the greater stability of the higher oxidation states of Re (and thus the greater tendency of reduced Re radiopharmaceuticals to undergo re-oxidation to perrhenate), and the greater substitution inertness of reduced Re complexes. These differences are illustrated in the preparation and use of 186Re (Sn)-HEDP and 99mTc(Sn)-HEDP diphosphonate radiopharmaceuticals designed, respectively, for palliative therapy and diagnosis of metastatic cancer to bone, and in the preparation and biodistribution of tr[186Re(DMPE)2Cl2]+ and [186Re(DMPE)3]+, analogs to the potential myocardial perfusion imaging agents tr-[99mTc(DMPE)2Cl2]+ and [99mTc(DMPE)3]+. [HEDP = (1-hydroxyethylidene)diphosphonate; DMPE = 1,2-bis(
Aqueous geochemistry of Rhenium in sulfidic environments	Dolor, MK; Helz, GR	GEOCHIMICA ET COSMOCHIMICA ACTA	72	12	A222	A222	2008	
Trace elements in the oceans	Donat JR;Bruland KW;			247		281	1995	Biosis copyright: Biol abs. Rrm book chapter human impact copper zinc contamination pollution environmental toxicology biogeochemistry
The Distribution Of Radioisotopes Of Some Heavy Metals In The Rat	Durbin PW;Scott KG;Hamilton JG;	University of California , Berkeley , Publications in Pharmacology	3				1957	The fate of 18 heavy metals was determined by tracing radioactive isotopes in Sprague-Dawley-rats, Curtis-Dunning-rats, and Slonaker-rats. Isotopes were prepared for molybdenum (7439987), tungsten (7440337), technetium (7440268), rhenium (7440155), ruthenium (7440188), osmium (7440042), rhodium (7440166), iridium (7439885), platinum (7440064), indium (7440746), palladium (7440053), thallium (7440280), tin (7440315), lead (7439921), cadmium (7440439), and mercury (7439976). Isotopes were administered parenterally or orally. Tissue deposition and excretion were monitored. Urine and feces were collected. The metals were divided into four groups based on absorption, distribution, and excretion. Cadmium and mercury were characterized by ease of gastrointestinal absorption and high accumulation and retention in liver and kidney. Indium, lead, tin, niobium (7440031), and tantalum (7440257) were characterized by relatively slow absorption from intramuscular injection with transient retention in liver and kidney and prolonged retention in skeleton. Molybdenum, tungsten, technetium, rhenium, osmium, and ruthenium were characterized by prompt and nearly complete urinary excretion. KEY STUDY DESCRIPTORS TO : Toxicity, pharmacology and all other biological effects. MA : Study in mammals (excluding humans). RD : Short-term or long-term exposure (repeated dosage): generally above 2 days. JE : Injection (or implantation) exposure (e.g. intravenous, subcutaneous or intraperitoneal).
Brain tissue reaction to some chronically implanted metals.	Dymond A.M., et al.	J. Neurosurg.	33		574		1970	
Inorganics	Eaton A;	J Water Pollut Control Fed	60		752	773	1988	Biosis copyright: Biol abs. Rrm review water pollution monitoring
The gas phase oxide and oxyhydroxide chemistry of trace amounts of rhenium	Eichler, R; Eichler, B; Gaggeler, HW; Jost, DT; Dressler, R; Turler, A	RADIOCHIMICA ACTA	87	03-Apr	151	159	1999	In preparation of experiments to investigate the chemical properties of bohrium (Bh, element 107) the behaviour of Re, its lighter homologue in group 7, was studied in different oxidizing chemical systems. The adsorption data of Re oxide and oxyhydroxide compounds on quartz surfaces were evaluated from results of thermochromatography experiments and confirmed in isothermal gas chromatography experiments applying 1 cm as standard state for the simple gas adsorption process: X(g)reversible arrow X(ads) (X = ReO3, HReO4) Delta H-ads(ReO3) = -190 +/- 10 kJ/mol; Delta S-ads(ReO3) = -179 +/- 30 J/mol K; Delta H-ads(HReO4)= -77 +/- 5 kJ/mol; Delta S-ads(HReO4) = -187 +/- 50 J/mol K. An on-line separation method for oxides and oxyhydroxides of short lived Re isotopes using isothermal high temperature gas-solid adsorption chromatography was developed. Separation yields and times of group 7 elements from lanthanides (model for actinides), polonium and bismuth were determined using the Re-169,Re-170,Re-174,Re-176, Er152-155, Ho151-154, Po-218, and Bi-214. An updated correlation function between the microscopic adsorption enthalpy and the macroscopic sublimation enthalpy was ca
Primary Data about accumulation of Rhenium in tumor tissue	Elena, Z; Artem, T; Maria, M; Zoya, S; Lidia, G; Nickolay, S; Avraam, B; Natalia, S; Alexander, S	Metal Ions in Biology and Medicine, Vol 9	9		331	334	2006	It was previously shown that radioactive isotopes 111,114 Re did not accumulate in any body parts of healthy rats and were excreted completely in 24 hours being introduced as potassium perrhenate. In our works cluster Rhenium compounds with organic ligands in liposome forms are investigated as antitumor substances. The main purpose of this paper was to analyze whether Rhenium accumulates in any organ of tumor-bearing rats. The most quantity of Re was found in urine collected during 21 days (100ppm), in tumor (0.5ppm - 2ppm) and in liver (1ppm). Other organs are not characterized by sufficient Re levels compared to control animals. Such a large quantity of Re in malignant tissue may contribute to antitumor activity of cluster Rhenium compounds in the process of chemoprevention.

Other Metals and Their Compounds	Elinder C;Zenz C;	Occupational Medicine, Third Edition , C Zenz , O B Dickerson , and E P Horvath , Jr , Editors	Mosby-Year					1994	The production of, uses of, and health effects associated with exposure to several metals encountered in diverse mining settings were reviewed. These included barium (7440393), bismuth (7440699), boron (7440428), copper (7440508),hafnium (7440586), iron (7439896), lithium (7439932), magnesium (7439954), molybdenum (7439987), palladium (7440053), platinum (7440064), rhenium (7440155), rhodium (7440166), silver (7440224), strontium (7440246), tantalum (7440257), thallium (7440280), tin (7440315), titanium (7440326), zinc (7440666), and zirconium (7440677). Experimental and/or human evidence of toxicity has been reported following exposure to these metals or their compounds with the exceptions of palladium, rhenium, rhodium, and inorganic tin compounds. Molybdenum and hafnium and their compounds have been thought to have few, minor toxic effects especially in humans. These metals and their compounds have not been reported to have carcinogenic effects, although a possible role for iron oxides as cocarcinogens has been suggested
Elemental composition of selected native plants and associated soils from major vegetation-type areas in missouri	Erdman JA;Shacklette HT;Keith JR;	U S Geol Surv Prof Pap %1976 , 954 -C () 87 Pp							EIS: Epidemiology Information System
Water analysis	Fishman MJ;Erdmann DE;Steinheimer TR;	Anal Chem		53	182R	214R		1981	Heep copyright: Biol abs. Review pesticide detergent heavy metal pollution poly chlorinated bi phenyl nitrate ammonia halide sewage drinking water sampling technique
Determination of anthropogenic input of Ru, Rh, Pd, Re, Os, Ir and Pt in soils along Austrian motorways by isotope dilution ICP-MS	Fritsche, J; Meisel, T	SCIENCE OF THE TOTAL ENVIRONMENT		325	01-Mar	145	154	2004	A joint study with the Federal Environment Agency of Austria was carried out to determine the distribution of Ru, Rh, Pd, Os, Ir and Pt (PGE) and Re in soils along major motorways. Emphasis was put on It as to date little is known about its anthropogenic input as this metal is now also used in automobile catalytic converters. Soil samples were analysed by ICP-MS through online-coupling of a chromatographic column to separate the PGEs from interfering matrix constituents. At all sampled sites not only Rh, Pd and Pt but also Ir and Re significantly exceed natural background values; concentrations reached 13 ng/g, 25 ng/g, 134 ng/g, 1.1 ng/g and 9.8 ng/g, respectively. The analytical procedure proved to be very selective and sensitive and, therefore applicable to routine soil analysis. (C) 2003 Elsevier B.V. All rights reserved.
Contribution of municipal effluents to metal fluxes in the St. Lawrence river	Gobeil, C; Rondeau, B; Beaudin, L	ENVIRONMENTAL SCIENCE & TECHNOLOGY		39	2	456	464	2005	The contribution of urban effluents to the total metal fluxes carried toward the sea by the St. Lawrence, a major world river, is 60% for Ag; 8-13% for Cu, Zn, Mo, Cd, and Bi; and less than 3% for all other measured elements (Al, V, Cr, Mn, Fe Co, Ni, As, Rb, Sr, Zr, Cs, Ba, W, Re, Pb,Th, U). This is inferred from measurements at the Montreal wastewater treatment plant. Except for Ag, municipal effluents do not weigh heavily on the St. Lawrence River metal budget, likely because of the physical-chemical primary treatment applied to most effluents. Compared to direct atmospheric deposition on the surface of the river, effluents would contribute half as much Pb and one-tenth as much Zn. In contrast, effluents deliver twice as much Cd and six times as much Cu as the atmosphere. Stable Pb isotope ratios ((206)pb/(207) Pb, Pb-206/Pb-208) in suspended particulate matter from the river indicate that the total Pb content in the river water is three times higher than the pristine level. The ratios of Cr, Ni, Cu, Zn, and Cd to Al in suspended particulate matter are high as compared to pre-industrial
PHARMACOLOGY AND TOXICOLOGY OF POTASSIUM PERRHENATE AND RHENIUM TRICHLORIDE	HALEY, TJ; CARTWRIG.FD	JOURNAL OF PHARMACEUTICAL SCIENCES		57	2	321 &		1968	
Leakage of a liquid 188Re-filled balloon system during intracoronary brachytherapy. A case report	Hausleiter J;Li A;Makkar R;Berman D;Robinson A;Litvack F;Eigler N;Whiting J;	Cardiovasc Radiat Med %2000 Jan -Mar	2(1):7-10.		Cardiovascular				We are reporting the first case of an accidental radioactive 188Re leakage of a liquid-filled balloon system. Different analytical methods estimated that approximately 4 mCi 188Re were released. The radiation burden was reduced considerably by the combined therapy with perchlorate and forced volume diuresis. Estimated exposures to all organs were very low with 1.8 rad. A total body nuclear scintigraphy demonstrated uniform 188Re distribution, without specific organ concentration
Trace element concentrations in fish from three adirondack lakes new york usa with different ph values	Heit M;Schofield C;Driscoll CT;Hodgkiss SS;	Water Air Soil Pollut		44	9		30	1989	Biosis copyright: Biol abs. Rrm catostomus-commersoni perca-flavescens human arsenic cadmium lead selenium thallium gallium mercury food industry pollution fishing industry muscle gut
Compound forms of fossil fuel fly ash emissions	Henry WM;Knapp KT;	Environ Sci Technol		14	450		456	1980	Heep copyright: Biol abs. A methodology program for the determination of inorganic compounds present in particulate emissions from fossil fuel combustion processes is described. Samples collected from power plants burning oil and coal fuels of different compositions provided a typical range of fly ashes for the investigations. Elemental (Cation/anion) Determinations of these were used to guide the compound methodology work. Water extractions of the samples were effective in the separation of soluble sulfate compounds from insoluble oxides and silicates, and this reduced the complexity of the compound forms remaining in the water-soluble and water-insoluble phases. A library of fourier transform ir reference spectra, prepared and stored for ready recall, was essential for identification of compound species. (The environmental significance of these data is discussed.)
Determination of rhenium in groundwater by inductively coupled plasma mass spectrometry with on-line cation exchange membrane sample cleanup	Ketterer ME;	Anal Chem		62	25	2522	2526	1990	Biosis copyright: Biol abs. A scheme is presented for determining rhenium in groundwater samples that contain up to 4000 mg dissolved solids by inductively coupled plasma mass spectrometry. A commercially available cation exchange membrane cartridge is used on-line to exchange cationic species for equivalent quantities of hydrogen ion; Rhenium, which is present as the perrhenate anion, remains on the upstream side of the membrane and is transported directly into the inductively coupled plasma. This arrangement successfully alleviates the matrix-related sample introduction difficulties and permits direct determination of rhenium in water with a detection limit of 0.03 Mug/l using a meinhard-type nebulizer. Removal efficiencies of up to 100% are achieved for sodium, magnesium, aluminum, potassium, and calcium ions, while perrhenate is transmitted with 100% efficiency. Results are presented for the determination of rhenium in ground water samples from the vicinity of a metal sulfide impoundment in the
Chemistry of rhenium as an analogue of technetium: Experimental studies of the dissolution of rhenium oxides in aqueous solutions	Kim, E; Boulegue, J	RADIOCHIMICA ACTA		91	4	211	216	2003	The migration of fissiogenic Tc into the environment can be predicted by studying the dissolution behavior of Re, a chemical analogue of Tc, avoiding the use of a radioactive element at high concentration. We developed a series of experimental studies of the solubility of Re oxides under various oxidation states (+VII, +IV, and +III), in oxidizing and anoxic media, so as to verify the validity of the available thermodynamic data concerning Re. The experimental results confirm that the predictable solubility of Re, under the conditions found in radioactive wastes storage, is very high when in the form of ReO4-, an analogue of TcO4-. The Re(III) oxide, Re2O3, is not stable in aqueous solutions and therefore the existence of Re(III) in surface conditions is not much likely. The Re(IV) oxide. ReO2, is weakly soluble. Its solubility is in the range 4 x 10(-7)-10(-6) mol L-1, which suggests that Re(IV) can be found in noticeable concentrations in aqueous solutions even in anoxic media; similar result is expected for Tc.
DETERMINATION OF RHENIUM IN MARINE WATERS AND SEDIMENTS BY GRAPHITE-FURNACE ATOMIC-ABSORPTION SPECTROMETRY	KOIDE, M; HODGE, V; YANG, JS; GOLDBERG, ED	ANALYTICAL CHEMISTRY		59	14	1802	1805	1987	
Pharmacokinetics of Tc-99(m)-pertechnetate and Re-188-perrhenate after oral administration of perchlorate: Option for subsequent care after the use of liquid Re-188 in a balloon catheter	Kotzerke, J; Fenchel, S; Guhlmann, A; Stabin, M; Rentschler, M; Knapp, FF; Reske, SN	NUCLEAR MEDICINE COMMUNICATIONS		19	8	795	801	1998	Radioactive wires and other linear sources are currently being used in clinical trials as endovascular brachytherapy to prevent restenosis after percutaneous transluminal coronary angioplasty. A new concept is the use of a liquid-filled balloon containing a beta-emitting radioisotope. A major advantage is optimal delivery of the radioactivity to the vessel wall. Rhenium-188 (Re-188) is a high-energy beta-emitter that is routinely available from a W-188/Re-188 generator in liquid form. Since Re-188-perrhenate could be released in the unlikely event of balloon rupture, we investigated whether, in analogy to pertechnetate, subsequent use of perchlorate can reduce the uptake of perrhenate in the thyroid. We performed static (n = 9) and dynamic (n = 11) thyroid scintigraphy with Tc-99(m)-pertechnetate to estimate the overall reduction in activity within 30 min and the washout from the thyroid after oral administration of 600 mg perchlorate (T-1/2). In two patients, Re-188 was injected to estimate the whole-body distribution and the discharge of thyroid activity after perchlorate use. Based
Toxicity Tests with Rhenium	L. C. Hurd, J. K. Colehour and P. P. Cohen	Proc. Soc. Exp. Biol. and Med.		30		926		1933	The lethal dose of manganese for rabbits is 5 to 6 mgrms. per kilo, of body weight (Hanzlik and Sollman), but in experiments with rhenium, the rare congener of manganese, the authors have injected into rats as much as 200 mgrms. per kilo. of body weight without producing any ill effects. Rhenium could be detected spectrographically, half an hour after injection, in the testes, heart, kidney, liver, and spleen, and especially in the urine
Toxicity Tests with Rhenium	L. C. Hurd, J. K. Colehour and P. P. Cohen	Pharm. J.		132		78		1934	The lethal dose of manganese for rabbits is 5 to 6 mgrms. per kilo, of body weight (Hanzlik and Sollman), but in experiments with rhenium, the rare congener of manganese, the authors have injected into rats as much as 200 mgrms. per kilo. of body weight without producing any ill effects. Rhenium could be detected spectrographically, half an hour after injection, in the testes, heart, kidney, liver, and spleen, and especially in the urine

Volatility literature of chlorine, iodine, cesium, strontium, technetium, and rhenium; technetium and rhenium volatility testing	Langowski MH;Darab JG;Smith PA;	Govt Reports Announcements & Index (GRA &I), Issue %19 , %2096					1919	Sponsored by Department of Energy, Washington, DCA literature review pertaining to the volatilization of Sr, Cs, Tc (and its surrogate Re), Cl, I and other related species during the vitrification of Hanford Low Level Waste (LLW) streams has been performed and the relevant information summarized. For many of these species, the chemistry which occurs in solution prior to the waste stream entering the melter is important in dictating their loss at higher temperatures. In addition, the interactive effects between the species being lost was found to be important. A review of the chemistries of Tc and Re was also performed. It was suggested that Re would indeed act as an excellent surrogate for Tc in non-radioactive materials testing. Experimental results on Tc and Re loss from sodium aluminoborosilicate melts of temperatures ranging from 900--1350(degrees)C performed at PNL are reported and confirm that Re behaves in a nearly identical manner to that of technetium
A biodistribution and elimination study of 188rhenium in pigs.	Li, AN; Hausleiter, J; Knapp, FF; Eigler, N; Whiting, JS	JOURNAL OF NUCLEAR MEDICINE	40	5	88P	88P	1999	
CONCENTRATIONS OF TRACE ELEMENTS IN GREAT-LAKES FISHES	LUCAS, HF; EDGINGTO.DN; COLBY, PJ	JOURNAL OF THE FISHERIES RESEARCH BOARD OF CANADA	27	4	677 &		1970	
Suboxic trace metal geochemistry in the eastern tropical North Pacific	Nameroff, TJ; Balistrieri, LS; Murray, JW	GEOCHIMICA ET COSMOCHIMICA ACTA	66	7	1139	1158	2002	We analyzed Al, Ti, Fe, Mn, Cu, Ba, Cd, U, Mo, V, and Re in water column, settling particulate, and sediment (0 to 22 cm) samples from the intense oxygen minimum zone (OMZ) of the eastern tropical North Pacific near Mazatlan, Mexico. The goal was to determine how the geochemistry of these elements was influenced by suboxic water column conditions and whether the sediments have a unique "suboxic" geochemical signature. The water column was characterized by a Mn maximum, reaching similar to8 nmol kg(-1) at 400 m. Concentrations of Cu, Ba, Cd, Mo, Re, U, and V were unaffected by the low 02 conditions and were comparable to those of the open ocean. Sinking particles were composed of lithogenic particles of detrital origin and nonlithogenic particles of biogenic origin. Al, Ti, and Fe were mostly (at least 79%) lithogenic. About 75% of the Mn was nonlithogenic. Significant amounts (at least 58%) of Cu, Ba, Cd, and Mo were nonlithogenic. Sediment geochemistry varied across the continental shelf and slope. Cadmium. U, and Re have prominent maxima centered at 310 in, with 12.3 ppm, 10.9 ppm, and 68.3 ppb, respectively, at the core top. High values of Mo (averaging 6.8 ppm) and V (ave
Ti, Zr, Hf; V, Nb, Ta; Cr, Mo, W; Mn, Tc, Re.	Newbery J.E.	Annual Reports Programme of Chemistry. Section A. Inorganic Chemistry. Royal Society of Chemistry. Cambridge, England. Berry F.J. et al. (Eds).					1988	KEY STUDY DESCRIPTORS RV : Review of specific toxicological aspects (indicated by additional keys), generally without original data. TE : Technical or technological aspects, including analysis, detection, physical data and non-biological effects.
Fate of fallout ingested by livestock part 1 dairy cows	Potter GD;Vattuone GM;Mcintyre DR;	U S Gov Res Dev Rep	71				1971 Apr	Heep copyright: Biol abs. Milk tungsten arsenic barium iodine rhenium ruthenium tellurium isotopes
Tetrahymena pyriformis: A tool for toxicological studies. A review	Sauvant MP;Pepin D;Piccinni E;	Chemosphere	38	1631		1669	1999	Biosis copyright: Biol abs. Among protozoa, tetrahymena pyriformis is the most commonly ciliated model used for laboratory research. After a brief description of the morphology and biology of tetrahymena pyriformis, this article focuses on the most important and recent investigations performed with this species in toxicology and ecotoxicology. The methodological features of its culture, and main tests, based on cell growth rate, biochemical markers, behavioral changes and motility, are discussed. Examples of xenobiotics (Organic and inorganic substances, pharmaceutical drugs, water pollutants) Tested with tetrahymena pyriformis are also given
[Radioprotection and environmental pollution by the use of the radionuclides 89Sr, 186Re, and 153Sm for pain palliation in metastatic bone diseases. Related calculations]	Sbonias, Evangelos	Hell J Nucl Med	8	2	68	73	2005	Due to the fact that the existing commercial analgesic drugs are not able to reduce effectively the pain caused by the metastatic bone disease, the use of radiopharmaceuticals with avidity to selectively localize in the metastatic skeletal sites, such as strondium-89 chloride (89Sr-Cl2), rhenium-186-hydroxy ethylene diphosphonate (186Re-HEDP), and samarium-153-ethylene diamine tetramethylene (153Sm-EDTMP), is widely accepted. However this medical application may be dangerous for the occupied personnel and more for general public, if radioactive waste is not properly disposed. In the following article we try to estimate the degree and the significance of that risk. For that reason we discuss the physical properties of these radionuclides and their distribution in the body of the patient. We conclude that 89Sr is not harmful for the physician, the attending personnel or those who live with the patient, because it radiates beta-radiation, while its gamma-radiation is negligeable. The radionuclides 186Re and 153Sm besides beta-radiation, also emit a perceptible amount of gamma-
Translocation of radionuclides of Co, Zn, Se, Rb, Y, Tc, and Re into organs of tomato plant via roots	Shinonaga, T; Ambe, S	BIOLOGICAL TRACE ELEMENT RESEARCH	104	1	71	82	2005	The translocation of the radionuclides of Co, Zn, Se, Rb, Y, Tc, and Re into red and green fruits, flesh, seeds, rind, calyxes, flower, leaves, and steins via the root of the tomato plant at two different growth stages was studied by a multitracer technique. The contents (%/g) of Co, Zn, Se, and Y in the roots were the highest among the organs, but only small amounts of them were translocated into the aerial parts after 5 d cultivation with a multitracer. In contrast, Rb, Tc, and Re showed rapid translocation into the stems and leaves from the root. In the plants cultivated for 95 d with a multitracer, Zn, Se, and Rb distributed in all of the organs, Co in the organs except for flowers, and Y, Tc, and Re in the limited organs. The translocation ratio of the elements for the edible part of the plants cultivated for 95 d decreased in order of Rb>Zn>Co&SIM; Se>Tc&SIM; Y>Re. The transfer factor of the elements for tomato fruit was determined to be in the range of 1.0(-5)-10(-2). The characteristic translocation behavior of the elements gives LIS fundamental information on the assessment of pollutant
Experimentally determined mobility of trace elements in soybean plants	Shinonaga, T; Prohl, G; Muller, H; Ambe, S	SCIENCE OF THE TOTAL ENVIRONMENT	225	3	241	248	1999	The mobility of Sc-46, Mn-54, Co-58, As-74, Se-75, Rb-83, Sr-85, Y-88, Eu-149, Gd-146, Yb-169, Hf-175, Re-183, and Ir-192 in soybean plants after foliar deposition was determined by a multitracer experiment. The plants were grown in a controlled area under no-rain conditions for different periods. They were exposed to multitracer-absorbed cellulose powder, and the radionuclide content in the seeds, pods, corpus, tunica, and roots was determined after they were harvested. Rubidium showed the highest mobility in the plant among those radionuclides followed by Se and Co which were classified as 'mobile'. Mn, As, Sr, and Re form a second class of 'medium mobility'. The contents of Sc-46, Y-88, Eu-149, Gd-146 Yb-169, Hf-175, and Ir-19 were below the detection limit in the seeds; these elements are classified as 'immobile'. The data obtained in this experiment cannot directly be converted into translocation factors applied in radioecological models, but they allow to check the classification used presently in such a model for elements on which little or no
Comparative geochemistry of cadmium, rhenium, uranium, and molybdenum in continental margin sediments	Sundby, B; Martinez, P; Gobeil, C	GEOCHIMICA ET COSMOCHIMICA ACTA	68	11	2485	2493	2004	The concentrations of authigenic phases of Cd, Re, U, and Mo increase with depth in four 45-cm-long sediment box cores collected along the axis of the Laurentian Trough, Gulf of St. Lawrence. Average authigenic accumulation rates, estimated from element inventories, are similar to rates in other continental margin environments. Strong regional variations in sediment accumulation rate and sulfide concentration have little influence on the accumulation rates of Cd and Re. This suggests that slow precipitation kinetics controls the accumulation of Cd and Re in these sediments. The accumulation rate of authigenic U is more variable; it may be tied to the kinetics of microbially mediated U reduction and be controlled by the availability of reactive organic matter. Authigenic Mo is distinguished by a sharp subsurface concentration minimum, above which Mo cycles with manganese. Mo released to pore water upon reduction of Mn oxides diffuses downward and enriches the subsurface sediment. Mo accumulates most rapidly in the sediment with the highest sulfide content.
[Industrial aerosols resulting from the condensation of tungsten, molybdenum and rhenium and their hygienic evaluation.]	Suvorov SV;	Gig Sanit %1963 , Apr	28:24-8.	Gigiena			1963	
Determination of bioavailable rhenium fraction in agricultural soils	Tagami, K; Uchida, S	JOURNAL OF ENVIRONMENTAL RADIOACTIVITY	99	6	973	980	2008	Rheniurn (Re) mobility in agricultural soils was studied in order to obtain information relevant to Tc-99 mobility in soil-to-plant systems. Since water soluble Tc and Re are highly bioavailable, extraction of Re with water was carried out in addition to a total Re determination in the soils. The geometric means of total Re for paddy field, upland field and other soils were 0.34, 0.23, and 0.28 ng g(-1), respectively, while those of water soluble Re (<0.45 mu m membrane filterable) were 0.053, 0.015 and 0.008 ng g(-1), respectively. There were no differences for total Re among soil uses; however, the water soluble Re/total Re ratio was significantly higher in paddy field soils (16%) than in other soil uses (6% for upland fields and 3% for other uses). Rheniurn mobility and plant availability were higher in paddy fields than in other agricultural fields, and similar phenomena would be expected for Tc-99. (C) 2007 Elsevier Ltd. All rights reserved.

A comparison of concentration ratios for technetium and nutrient uptake by three plant species	Tagami, K; Uchida, S	CHEMOSPHERE	60	5	714	717	2005	Technetium (Tc) is a non-essential element for which accumulation mechanisms in plants have recently been discussed, but only from the viewpoint of existence of anion transport proteins in plant cells. In this study, using three kinds of plants (Cucumis sativus L., Raphanus sativus L., and Brassica chinensis L.), uptake of Tc and Re (a chemical analogue of Tc) were observed. The results showed that Tc and Re uptake occurred not only with water mass flow or active nutrient uptake, but also with uptake of nutrient cations such as K+. It is suggested here that most stable chemical form under aerobic conditions, TcO4-, is used in cation transport as a substitute ions, such as Cl-. After TcO4- passes through a root surface, it moves through the xylem together with cations. Due to these uptake mechanisms, Tc is highly accumulated in plants. (c) 2005 Elsevier Ltd. All rights reserved.
Comparison of transfer and distribution of technetium and rhenium in radish plants from nutrient solution	Tagami, K; Uchida, S	APPLIED RADIATION AND ISOTOPES	61	6	1203	1210	2004	Tracer experiments were carried out to compare the plant uptake behavior of Tc and Re from nutrient solutions. Radish plants, transplanted to nutrient solution including various tracers, showed the same uptake and distribution of Tc-95m and Re-183. The trend was the same when the Tc-99 and stable-Re concentrations were increased in nutrient solution. The behavior of other elements was different from that of Tc and Re. These findings suggest the possible use of Re as the chemical analogue of Tc in soil solution to plant uptake experiments. (C) 2004 Elsevier Ltd. All rights reserved.
Study of the possibility of rhenium extraction and preconcentration from plants	Tzvetkova, C; Bozhkov, O; Russeva, E	LECTURE NOTES ON ENERGY AND ENVIRONMENT			253	256	2007	Investigation was carried out on leaves of green geranium (Pelargonium) grown on soil spiked with perrhenate and containing a known amount of bioaccumulated rhenium. Two ways of rhenium. extraction and preconcentration from green leaves of geranium were studied: i) direct incineration of the raw leaves and alkaline leaching of rhenium. from the ash; ii) ethanol extraction of rhenium from raw leaves followed by evaporation of ethanol, ashing of dry residue and alkaline extraction of rhenium from the ash. It was found possible to concentrate rhenium 24 444 times (as compared to its initial concentration in soils) using ethanol extraction from green plant mass in the remaining ash. A better (in comparison with the case of direct incineration of raw leaves) preliminarily purification of the leaching alkaline solutions from major ash cations (K, Ca, and Mg) was achieved by ethanol extraction of rhenium, The investigation revealed that it was possible to develop a cheap and environmentally friendly biotechnology for rhenium recovery from soils and waters using plants.
Determination of rhenium traces in river water by Q-ICP-MS and HR-ICP-MS	Uchida, S; Tagami, K; Saito, M	JOURNAL OF RADIOANALYTICAL AND NUCLEAR CHEMISTRY	255	2	329	333	2003	A simple separation method was applied to determine rhenium in river water using Q-ICP-MS and HR-ICP-MS. Re was concentrated from 420925 ml river water using a TEVA resin minicolumn. Such extraction using a resin could separate Re from most sample matrices and trace elements. Almost 100% recovery was found throughout the method as determined with radioactive multitracers. The HR-ICP-MS was also used for the direct determination because of its low detection limit for Re (0.007 pg/ml). The Re concentration in the river water samples ranged from 0.9 to 6.5 pg/ml and the three analysis results showed good agreement with each other.
Metabolic cycles for toxic elements in aqueous systems	Wood JM;	Rev Int Oceanogr Med	31-32					Heep copyright: Biol abs. The elements are classified according to their toxicity and availability; Toxic and relatively accessible elements such as hg and as are studied in detail. Two types of equilibria, inorganic and organometallic, are considered. When an element is introduced into an environment rich in microbial activity, each valence state is made available for metabolic interconversions. The interconversion of inorganic complexes to organometallic complexes is important because the latter are readily transported and accumulated into tissues of highlipid content. This interconversion is made by methylating agents which are available for methyl transfer reactions in biological systems. The hg and as cycles are summarized
Biological cycles for toxic elements in the environment	Wood JM;	Science (Wash D C)	183				1974 Oct	Heep copyright: Biol abs. These substances can be categorized as naturally occurring toxic elements and compounds and toxic compounds that are synthesized industrially. The danger associated with naturally occurring elements and compounds depends on their distribution in the environment. Some of chemical and biochemical transformations of environmental toxic elements (Heavy metals and metalloids) Are described, special emphasis is placed on the role played by microorganisms. Present knowledge of the biological cycles of toxic elements enables the prediction of the behavior of other toxic elements in the environment
RESPONSES OF PLANTS TO RHENIUM	WOOD, RD; HARRISON, HC	PLANT PHYSIOLOGY	28	4	755	758	1953	
Solubility and speciation of rhenium in anoxic environments at ambient temperature and applications to the Black Sea	Xiong, YL	DEEP-SEA RESEARCH PART I-OCEANOGRAPHIC RESEARCH PAPERS	50	5	681	690	2003	The aqueous speciation of rhenium at the temperatures on or near the Earth's surface, especially in anoxic environments, is not well known. For the first time, the relative importance of ReO4- and the neutral rhenium species, Re(OH)04, is thermodynamically modeled in anoxic environments at ambient temperature where ReS2 or its solid solution(s) is likely to control the solubility. This thermodynamic model suggests that ReO4- is an insignificant species in anoxic environments. In comparison to observed total rhenium concentrations in anoxic waters (from similar to3 to similar to30 pmol/kg), the contribution from ReO4- would be less than 10(-8) ppb (similar to4 x 10(-5) pmol/kg). In contrast, the neutral rhenium species is an important species in anoxic environments. At SigmaH(2)S= 10(-4) molal, 10(-2) ppb (similar to40 pmol/kg) of Re(OH)(4)(0) can exist in equilibrium with ReS2 in the HS- field at a pH of about 9 or under the oxygen fugacity conditions imposed by the HS-/SO42- redox couple, demonstrating its importance in anoxic environments. Applications of the
Comparison of reductive accumulation of Re and Os in seawater - sediment systems	Yamashita, Y; Takahashi, Y; Haba, H; Enomoto, S; Shimizu, H	GEOCHIMICA ET COSMOCHIMICA ACTA	71	14	3458	3475	2007	In order to understand the fractionation of Re and Os in marine environments, their removal from artificial seawater to Tokyo Bay sediments is studied using a multitracer technique. The chemical processes of the removal of Re and Os are also estimated based on their speciation analyses by X-ray absorption fine structure (XAFS) spectroscopy. The partitioning experiments, which use the multitracer technique, provide information on Re and Os regarding (i) their distributions between artificial seawater-sediment systems, (ii) their complexation with humic acid, and (iii) their carriers in sediments. In addition, XAFS spectroscopy provides direct information on the chemical states of Re and Os in the sediments. In an artificial seawater-sediment system containing a multitracer, Re is removed from the artificial seawater only under a reducing environment. The speciation of Re by X-ray absorption near-edge structure (XANES) suggests that the majority of Re remains as ReO4- in the artificial seawater even under highly reducing conditions, during laboratory time scale
HIGH RHENIUM ENRICHMENT IN BROWN-ALGAE - A BIOLOGICAL SINK OF RHENIUM IN THE SEA	YANG, JS	HYDROBIOLOGIA	211	3	165	170	1991	Twenty-one species of seaweed from the California coast were analyzed for rhenium. For the first time, high enrichment (thousandfolds) of rhenium relative to seawater was found in brown algae, but not in green or red algae. Brown algae was suggested as a biological sink of rhenium in the sea and the analogous behavior of technetium to rhenium was found in marine algae. Preliminary incubation experiments with a common brown alga (Pelvetia fastigiata) showed that algal surface is not a major accumulating locus of rhenium.
Kinetics of perrhenate uptake and comparative biodistribution of perrhenate, pertechnetate, and iodide by NaI symporter-expressing tissues in vivo	Zuckier, LS; Dohan, O; Li, Y; Chang, CJ; Carrasco, N; Dadachova, E	JOURNAL OF NUCLEAR MEDICINE	45	3	500	507	2004	Pertechnetate (as (TcO4-)-Tc-99m), I-123(-), and I-131(-) have a long and successful history of use in the diagnosis and therapy of thyroid cancer, with uptake into thyroid tissue mediated by the sodium-iodide symporter (NIS). NIS has also emerged as a potential target for radiotherapy of nonthyroid malignancies that express the endogenous or transfected symporter. Perrhenates (as (ReO4-)-Re-188 and (ReO4-)-Re-186) are promising therapeutic substrates of NIS, although less is known about their behavior in vivo. In this study, we endeavored to characterize the biologic behavior of perrhenate, especially in relation to iodide and pertechnetate, to better explore its possible therapeutic role. Methods: We describe the simultaneous biodistribution and uptake in vivo of iodide, pertechnetate, and perrhenate in groups of healthy CD1 mice, either with or without coadministration of perchlorate (ClO4-), a potent NIS inhibitor. Animals administered single radiopharmaceuticals were imaged as a means of illustrating these findings. Kinetic properties of perrhenate were